

## SECTION 700. WORK ZONE TRAFFIC CONTROL, SIGNING AND PAVEMENT MARKING

### SECTION 701. WORK ZONE TRAFFIC CONTROL

**701.01 Description.** This work shall consist of the furnishing, installation, maintenance, relocation, and removal of all traffic control devices according to the contract.

**701.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) Flashing and Steady Burning Barricade Lights ..... | 1084.01         |
| (b) Pavement Marking Tape .....                        | 1095.06         |
| (c) Construction and Maintenance Signs .....           | 1084.04         |
| (d) Reflective Sheeting .....                          | 1084.02         |
| (e) Temporary Rumble Strips .....                      | 1084.03         |

### CONSTRUCTION REQUIREMENTS

#### **701.03 Equipment.**

| Item                                | Article/Section |
|-------------------------------------|-----------------|
| (a) Arrow Boards .....              | 1106.03         |
| (b) Sign Trailers .....             | 1106.04         |
| (c) Truck Mounted Attenuators ..... | 1106.01         |

#### **701.04 General.**

- (a) Applications. Traffic control and protection shall be according to the traffic control plan, Section 702 Traffic Control Devices, or as directed by the Engineer. The number, type, color, size, and placement of all traffic control devices shall be according to the traffic control plan, the Department's "Manual on Uniform Traffic Control Devices for Streets and Highways", and the Department's "Quality Standard for Work Zone Traffic Control Devices".

All existing pavement markings which conflict with the revised traffic pattern shall be removed according to Section 783.

Work shall not begin until the Engineer has determined the traffic control devices meet the quality requirements. Traffic control standards or designs included in the plans specify the minimum required combination of traffic control devices needed for a particular construction operation. Revisions or modifications of these standards or designs to fit field conditions shall be approved by the Engineer in writing.

Conditions created by the Contractor's operation, and not controlled by the contract shall be protected by safety devices at the Contractor's expense and as directed by the Engineer.

Temporary traffic control devices shall remain in place only as long as needed and shall be removed as soon as practical when directed by the Engineer. Placement of any of these devices may be adjusted to fit field conditions. Signs that do not apply to current conditions, shall be removed, covered, or turned from the view of motorists. Any traffic control device which has become ineffective due to damage or defacement shall be replaced by the Contractor. All traffic control devices shall be kept clean and properly oriented in reference to traffic.

At the preconstruction conference, the Contractor shall furnish the name of the individual in the Contractor's direct employ who is to be responsible for the installation and maintenance of the traffic control for the project. When the actual installation and maintenance are to be accomplished by a subcontractor, consent shall be requested of the Engineer at the time of the preconstruction conference. This shall not relieve the Contractor of furnishing a responsible individual in the Contractor's direct employ. The Department will provide the Contractor the name of its representative who will be responsible for the administration of the Traffic Control Plan.

For all projects which affect the flow of traffic for more than one day, form BT 725 will be required.

The maximum length of lane closure on multilane highways shall not exceed one day's production or 5 km (3 miles), whichever is greater, except lane closures up to 8 km (5 miles) in length will be permitted for portland cement concrete patching and continuously reinforced concrete patching operations. Gaps between successive lane closures shall not be less than 3 km (2 miles) in length.

(b) Contractor's Operations and Equipment.

- (1) General. The Contractor shall keep all equipment, material, and vehicles off the pavement and shoulders on the side of the pavement which is open to traffic. Except where controlled by flaggers, the Contractor shall operate vehicles and equipment in the direction of traffic while traveling and working on the pavement and shoulders of a two-lane two-way highway. On a multilane highway, the Contractor shall operate vehicles and equipment in the direction of traffic while traveling and working on the pavement and shoulders.

Excavation for construction on both sides of the pavement at any one location at the same time will not be permitted. At any location on existing pavements less than three lanes in width, the sequence of construction shall limit operations to one side of the pavement.

The maximum allowable differential in elevation between adjacent open traffic lanes shall be 50 mm (2 in.). At locations where construction operations result in a differential in elevation exceeding 75 mm (3 in.) between the edge of pavement or edge of shoulder within 900 mm (3 ft) of the edge of the pavement and the earth or aggregate shoulders, Type I or II barricades or vertical panels shall be placed at 60 m (200 ft)

centers on roadways where the posted speed limit is 45 mph or greater and at 30 m (100 ft) on roadways where the posted speed is less than 45 mph. This delineation will be considered as included in the contract unit prices for the work and no additional compensation will be allowed.

- (2) **Surveillance.** When open holes, broken pavement, trenches over 75 mm (3 in.) deep and 100 mm (4 in.) wide or other hazards are present adjacent to an open lane, in a closed lane, or adjacent to the closed lane, the Contractor shall furnish Traffic Control Surveillance during all hours when the Contractor is not engaged in construction operations. The surveillance person(s) shall be provided with adequate transportation and communications to ensure deficiencies can be corrected. The surveillance person(s) shall drive over and inspect the work, maintain the temporary traffic control devices, and assist and direct traffic, at such intervals as may be required, not to exceed four hours. The person responsible for surveillance shall complete an inspection form, furnished by the Engineer, on a daily basis. The completed form shall be given to the Engineer on the first working day after the inspection.
- (3) **Equipment Parking and Storage.** During working hours, all vehicles and/or nonoperating equipment which are parked, two hours or less, shall be parked at least 2.5 m (8 ft) from the open traffic lane. For other periods of time during working and for all nonworking hours, all vehicles, materials, and equipment shall be parked or stored a minimum of 9 m (30 ft) from the pavement when the project has adequate right of way. When adequate right of way does not exist, vehicles and materials shall be located at least 4.5 m (15 ft) from the edge of any pavement open to traffic, unless located behind temporary concrete barrier, temporary bridge rail, or other man-made or natural barriers. Temporary barriers erected for protection by the Contractor shall meet the approval of the Engineer. When authorized by the Engineer, vehicles, materials, or equipment may be parked or stored, less than 4.5 m (15 ft) from any pavement open to traffic.

Any unattended obstacle or excavation in the work area which constitutes a hazard in the opinion of the Engineer, shall be protected by barricades at 15 m (50 ft) centers, having flashing lights at night. If the hazard exceeds 30 m (100 ft) in length, steady burning lights shall be substituted for flashing lights. When the distance is greater than 75 m (250 ft), barricade spacing may be increased to 30 m (100 ft).

When not being utilized to inform and direct traffic, construction speed limit signs, arrow boards, and message boards shall be treated as nonoperating equipment.

- (4) **Crossovers.** The Contractor will be permitted to make "U" turns across the median at existing maintenance crossovers or crossovers constructed by the Contractor, provided the width of the crossover is adequate to ensure no disruption of traffic on the through lanes and at locations permitted by the Engineer. The use of median crossovers will not be permitted within 400 m (1320 ft) of the speed change taper of an

interchange ramp, within 600 m (2000 ft) of the taper for a lane closure, or when the construction traffic will be entering or exiting the only open lane within a construction zone. Crossovers shall conform to minimum sight distance requirements. The cost of constructing, maintaining, and removing temporary crossovers and the restoration of the median shall be at the Contractor's expense. When the crossover is being used, two signs shall be placed in the median and two signs shall be placed opposite on the outside shoulder of the highway in advance of the crossover on the side where trucks enter the highway. The first pair, approximately 300 m (1000 ft) from the crossover, shall be 1.2 m (48 in.) "MERGE RIGHT" signs. The second pair, approximately 450 m (1500 ft) from the crossover, shall be 1.2 m (48 in.) "TRUCKS ENTERING ON LEFT" signs. The warning signs in advance of the crossover in the other direction shall be as listed above except the second pair shall be "TRUCKS LEAVING ON LEFT". All warning signs required at median crossovers shall be at the Contractor's expense.

(c) Flaggers.

- (1) General. The flagger shall be stationed to the satisfaction of the Engineer and be equipped with a vest of fluorescent orange, fluorescent orange with strong yellow/green stripes or strong yellow/green vest having fluorescent orange stripes and approved flagger traffic control signs conforming to Standard 702001 and Article 702.05(e). The longitudinal placement of the flagger may be increased up to 30 m (100 ft) from that shown on the plans to improve the visibility of the flagger. Flaggers will not be required when no work is being performed, unless there is a lane closure on two-lane, two-way pavement.
- (2) Two Lane Highways. Two flaggers will be required for each separate operation where two-way traffic is maintained over one lane of pavement. Work operations controlled by flaggers shall be no more than 1600 m (1 mile) in length. Flaggers shall be in sight of each other or in direct communication at all times. Direct communication shall be obtained by using portable two-way radios or walkie-talkies.
- (3) Multilane Highways. At all times where traffic is restricted to less than the normal number of lanes on a multilane pavement with a posted speed limit greater than 40 mph and the workers are present, but not separated from the traffic by physical barriers, a flagger shall be furnished to protect the workers and to warn and direct traffic. One flagger will be required for each separate activity of an operation that requires frequent encroachment in a lane open to traffic.
- (4) Flagger Certification. All flaggers engaged in work zone traffic control operations are required to be certified by the Illinois Department of Transportation or by an agency approved by the Department. While on the job site, each flagger shall have in his/her possession a current drivers license and a current flagger certification I.D. meeting Department requirements. For non-drivers, the Illinois Identification Card issued by the Secretary of State will meet the requirement for a current drivers license. This flagger certification shall not apply to any

emergency situations that arise due to actions beyond the Contractor's control where flagging is needed to maintain safe traffic control on a temporary basis.

- (5) **Flagger Signals.** The flagger signaling methods shall comply with those contained in the Department's Flagger Handbook.
- (6) **Night Time Flagging.** The flagger station shall be lit by additional overhead lighting other than street lights. The flagger vest shall have vinyl retroreflective stripes that maintain retroreflectivity when wet. The retroreflective material shall be orange, yellow, white, silver or strong yellow/green. It shall be visible at a minimum distance of 300 m (1000 ft) and shall be designed to identify the wearer as a person through the full range of body motions.
- (d) **Traffic Control Modification.** Revisions in the staging of construction or maintenance operations may require traffic control to be installed according to Standards other than those included in the contract plans. If required, the Standards will be made available to the Contractor at least one week in advance of the modification of the traffic control. A modification to increase the traffic control shown in the plans by the Contractor must be submitted to the Engineer for approval. A reduction in the traffic control will not be allowed except as provided herein.

A reduction in the number of flaggers from that shown on the contract may be permitted when the road is closed to through traffic and it is necessary to provide access for local traffic. If the average daily traffic is 400 or more, or is not shown in the contract, the Contractor shall furnish flaggers and traffic control devices according to the contract. When the road is closed to through traffic, but open to local traffic and the average daily traffic, as shown in the plans is less than 400, but more than 100, one flagger will be required for each separate operation where two-way traffic is maintained over one lane and no flaggers will be required where at least one unobstructed lane of traffic is maintained, in each direction on multilane pavements. When the average daily traffic is less than 100, no flaggers will be required unless the Contractor's operation encroaches on the open traffic lane, during which time one flagger shall be provided at the Contractor's expense. If the average daily traffic volume is less than 400, the Engineer may require additional flaggers to protect hazardous conditions and such additional flaggers will be paid for according to Article 109.04.

- (e) **Temporary Rumble Strips.** Temporary rumble strips shall be placed snugly against one another and attached to the pavement with an adhesive meeting the recommendations of the rumble strip manufacturer.
- (f) **Truck Mounted Attenuators.** Trailing vehicles shall be between 60 m and 150 m (200 ft and 500 ft) behind the lead vehicles.

**701.05 Specific Procedures.**

## (a) Shoulders.

## (1) Aggregate.

When bituminous resurfacing is being constructed and the road is opened to traffic, there shall be no more than 6.5 lane km (4 lane miles) of new binder or surface adjacent to the shoulder without either completing the shoulders, providing barricades or vertical panels, erecting "LOW SHOULDER" signs at 3.2 km (2 miles) intervals, or constructing a temporary earth wedge against the edge of pavement and compacting it to the satisfaction of the Engineer.

For edge of pavement/shoulder drop-offs exceeding 76 mm (3 in.) the Contractor shall provide barricades or vertical panels according to Article 701.04(b)(1).

## (2) Portland Cement Concrete. When the curing period for the concrete shoulders, as required in Article 1020.13, has been completed, the Engineer will determine when traffic will be permitted on the shoulders.

No traffic will be permitted on the shoulders until test specimens, according to Article 1020.09, have attained a minimum flexural strength of 3,500 kPa (500 psi), or a minimum compressive strength of 19,000 kPa (2,700 psi). If such tests are not conducted, traffic will not be permitted on the shoulders until 14 days after the concrete is placed. The Contractor may request additional test specimens be made and tested if he/she wishes to permit traffic on the shoulders earlier than the normal testing frequency. These specimens will be cured in the same manner as the shoulders.

## (b) Base Course.

## (1) Aggregate Base Course. The road or any section 1.5 km (1 mile) or more in length shall be opened to traffic immediately after it has been completed.

## (2) Soil-Cement Base Course. The finished soil-cement base course may be opened immediately to local traffic and to the Contractor's construction equipment. The base may be opened to all traffic after the seven day protection period, provided the base course is not damaged, marred, or distorted by such traffic, and provided the protection and cover specified in Article 352.12 is not impaired.

## (c) Surface Courses and Pavement. Where construction operations on two-lane roads open to traffic result in the removal or covering of any pavement striping indicating passing restrictions, "NO PASSING ZONES NOT STRIPED NEXT MILES" signs shall be used. The Contractor shall place the signs at the beginning of the unstriped area, just beyond each major intersection within the unstriped area, and at other locations as directed by

the Engineer to ensure a minimum spacing of 8 km (5 miles). The signs shall be placed just prior to removal or covering of the striping and shall remain in place until full no passing zone striping has been restored.

- (1) Prime Coat. The "FRESH OIL" (W21-2) sign shall be erected when prime and fine aggregate are applied to pavement that is open to traffic. The signs shall remain until tracking of the prime ceases as directed by the Engineer. The signs shall be erected a minimum of 150 m (500 ft) preceding the start of the prime.
- (2) Cold Milling. The "ROUGH GROOVED SURFACE" (W8-I107) signs shall be erected when the road has been cold milled and opened to traffic. The signs shall remain in place until the milled surface condition no longer exists. These signs shall be erected a minimum of 150 m (500 ft) preceding the start of the milled pavement and shall have an amber flashing light attached.
- (3) Bituminous Concrete Binder and Surface Course Class I. The road shall be kept open to traffic on the existing pavement or on the new work. During the actual cleaning of the pavement and the placing of the mixture for cracks, joints and flangeways, prime coat, leveling binder, binder and surface courses, one-way traffic will be permitted. At all other times, two-way traffic will be allowed to use the road.
- (4) Bituminous Treated Earth Surface. When blotter aggregate is not specified, the road shall be closed to traffic during the application of the bituminous material and shall remain closed for a period of not less than 48 hours after the final application, or longer if deemed necessary by the Engineer. Excess bituminous material remaining on the surface at the time the road is closed to traffic, shall be covered with a thin layer of loose earth sufficient to absorb the surplus bituminous material.

When blotter aggregate is specified, the road may be opened to traffic immediately after the application of blotter aggregate.

- (5) Bituminous Surface Treatment and Surface Plant Mix (Class B). The surface may be opened to traffic as soon as it has cured sufficiently to prevent the material from being picked up by the wheels of vehicles passing over it.
- (6) Portland Cement Concrete Pavement. When the curing period for the pavement, according to Article 1020.13, has been completed and the joints have been sealed, as required in Article 420.10, and protective coat, when required, is applied, the Engineer will determine when the pavement shall be opened to traffic. The earliest the pavement will be opened to traffic will be when test specimens according to Article 1020.09 have attained a flexural strength of 4,500 kPa (650 psi) or a compressive strength of 24,000 kPa (3500 psi). If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete is placed. Prior to opening to traffic, the pavement shall be cleaned. The Contractor may request additional test specimens be made and tested if the Contractor wishes to open the

pavement to traffic earlier than the normal testing frequency. These specimens will be cured in the same manner as the pavement. All traffic including construction traffic shall be limited to legal axle weights (legal loads).

(d) Structures.

- (1) Concrete Superstructures and Floors. Concrete superstructures and floors shall be opened to traffic according to Articles 503.05, 503.06, and 1020.13 and after protective coat, when required, is applied and final texturing or grooving is completed unless stage construction is utilized. On projects utilizing stage construction, saw cut grooving may be deferred until at least two adjacent lanes have been constructed.
- (2) Box and Pipe Culvert Extensions. Box culvert and pipe culvert extensions shall be protected with barricades until the backfill over the extensions is complete and no longer poses a hazard to traffic.
- (3) Storm Sewers Jacked in Place. The construction operations shall be carried on without encroachment upon the traveled way by either the excavation or by the storage of equipment or materials. When open cut excavation encroaches upon the shoulder, the excavation shall be protected according to Article 701.04(b).
- (4) Bridge Washing. The entire bridge roadway and roadways below shall be kept open to traffic at all times, other than when actual work is being performed. While actual work is being performed, one-half the roadway may be closed to traffic at the option of the Contractor. One-way traffic shall be permitted over the other half of the roadway if the bridge roadway is less than 12.2 m (40 ft) in width. Two-way traffic shall be permitted over the other half of the roadway if the bridge roadway width is 12.2 m (40 ft) or more between curbs. Traffic control devices shall be as specified for each bridge.

(e) Pavement Patching.

- (1) Keeping Road Open to Traffic. Traffic shall be permitted to use the road at all times. All construction operations shall be arranged to facilitate the movement of traffic.
  - a. Open Traffic Lane. On two-lane pavements, construction operations shall be confined to one traffic lane, leaving the opposite lane open to traffic. On four-lane pavement, construction operations shall be confined to one traffic lane in each direction, leaving the other two traffic lanes open to traffic throughout the period of construction.
  - b. Temporary Traffic Control Devices. In addition to the traffic control and protection shown elsewhere in the contract for multi-lane pavement, the Contractor shall place two barricades or drums without lights immediately in front of each open patch or other excavation within a closed lane adjacent to an open lane where



temporary concrete barriers are not used to separate traffic from the work area. One barricade or drum shall be placed at the edge of the open traffic lane and one barricade or drum centered in the closed lane. A check barricade shall be placed in the middle of the closed lane and at the shoulders at 300 m (1000 ft) centers. Requirements for lights on barricades or drums will be according to Article 702.03(e) and 702.04.

When patching on ramps, a minimum of three standard 1.2 m (48 in.) signs ("RAMP CONSTRUCTION", "NARROW LANE", and "FLAGGER" or Flagger Symbol signs) and one flagger shall be required as directed by the Engineer. The work area shall be delineated by Type I or Type II barricades at 15 m (50 ft) spacing or closer if directed by the Engineer. Cones may be substituted for barricades during daylight hours. This work shall be included in the cost of Standard 701406 or 701401.

Barricades or drums being used to separate traffic from the work area may be moved up to 15 m (50 ft) from their specified location. Flaggers, when required, shall be provided according to Article 701.04(c).

- c. Scoring. As soon as the scoring operations are completed and before the barricades are removed, all spalls and broken pieces of concrete shall be removed from the pavement and shoulders. Waste material shall be disposed of by the Contractor according to Article 202.03.

- d. Broken Pavement and Open Holes.

- 1. Multilane Roadways. The total area of pavement broken and not removed for concrete patching shall not exceed 1/2 of the total area of broken pavement which can be removed in an average day's work. The total area of holes left open overnight for concrete patching shall not exceed 1/2 of the pavement area which can be replaced in an average day's work. All open holes, broken pavement and patches shall be barricaded as shown on the plans. No materials removed from patches shall remain on the right of way overnight.

No open holes, broken pavement, or partially filled holes shall remain overnight on bituminous patching or when use of the special patching mixture is required, except for conditions beyond the Contractor's control.

- 2. Two Lane Roadways and Ramps. No open holes, broken pavement, or partially filled holes shall remain overnight and all barricades shall be removed before dark, except for conditions beyond the Contractor's control.

(2) Opening Road to Traffic.

- a. Cleaning Up. Prior to opening the pavement to traffic, the entire right of way adjacent to the patching operations shall be cleared of all materials caused by the Contractor's operations, and the backfill along the shoulder edge of the pavement shall be compacted to the satisfaction of the Engineer.
- b. Strength Tests. The patch may be opened to traffic when test specimens cured with the patch have obtained a minimum flexural strength of 4,100 kPa (600 psi) or a compressive strength of 22,000 kPa (3200 psi). With the approval of the Engineer, concrete strength may be determined through the use of a maturity meter according to AASHTO T 276. At the age of two days, testing will be permitted for high-early-strength concrete, rich-mix portland cement concrete, or a concrete mixture containing an approved accelerator.
- c. Special Mixture. The special patching mixture according to Article 1020.05(g)(2) shall be utilized when specified. These patches shall be cured and opened to traffic during daylight hours on the same day the patches are constructed.

Patches constructed of the special patching mixture on ramp pavements and two-lane pavements with two-way traffic may be open to traffic when beams cured with the patches achieve a flexural strength of 2100 kPa (300 psi), or a compressive strength of 11,000 kPa (1600 psi) determined as specified in Article 1020.09. For all other pavements, patches constructed with the special patching mixture may be opened to traffic when beams cured with the patches achieve a flexural strength of 3800 kPa (550 psi) or a compressive strength of 20,200 kPa (2,933 psi).

When use of the special patching mixture is required and patches cannot be opened before sunset, the additional traffic control required will be provided by the Contractor at his/her own expense. The Contractor will be required to change his/her operations if she/he consistently cannot have all patches open before nightfall.

- (f) Guardrail. Traffic control for the installation, maintenance, and/or removal of guardrail shall be provided, as applicable to two-lane or multi-lane roadways, according to the following Highway Standards included in the plans:

| <u>Two-lane Roadways</u> | <u>Multi-lane Roadways</u> |
|--------------------------|----------------------------|
| Standard 701006          | Standard 701101            |
| Standard 701011          | Standard 701106            |
| Standard 701201          | Standard 701406            |
| Standard 701301          | Standard 701426            |
| Standard 701311          |                            |

In addition to applicable Standard requirements, Type I or II barricades with lights shall be placed at 15 m (50 ft) centers at all locations where guardrail is temporarily removed or where the installation is incomplete. The barricades shall remain in place until the guardrail installation is completed.

Guardrail removal and/or installation shall be coordinated to prevent delays in completion. Guardrail removal and/or installation shall be scheduled so no installations are left unfinished when the work is suspended for the winter or other extended periods of time.

These Standards will not be paid for separately and all costs shall be included in the applicable guardrail installation, maintenance, and/or removal pay items.

**701.06 Highway Standards Application.** Standards for work zone traffic control shall be applied to locations according to existing posted speed limits.

- (a) Standard 701006 and 701011. When the work operation requires four or more work vehicles enter through traffic lanes in a one hour period, a flagger shall be provided and a "FLAGGER" sign shall be substituted for the "WORKER" sign.
- (b) Standard 701316 and 701321. The exact location of the signals, detector loops, stop bars, and signs shall be as directed by the Engineer.

Advisory speed signs or plates, showing a speed of 10 mph less than the normal posted speed shall be installed.

The Contractor shall notify the Engineer for inspection, at least 72 hours in advance of placing the signals in operation.

The District Engineer shall be notified one week prior to a traffic lane width reduction.

Any damage to the temporary traffic signals from any cause shall be repaired at the Contractor's expense. If at any time the Contractor fails to perform any work deemed necessary by the Engineer to keep the temporary traffic signals in proper operating condition, the Department reserves the right to have other electrical Contractors perform the needed work, and the cost will be deducted from compensation due or which may become due the Contractor under the contract.

- (1) Standard 701316. During daytime operations when workers are present, the Engineer may allow Type I or Type II barricades to be placed parallel to the centerline. Cones may be substituted for barricades at half the barricade spacing during the daytime operations.
- (2) Lane Closure on Two-Way, Two-Lane Rural Road. The Contractor shall furnish, install, maintain, and remove temporary traffic signals including a traffic actuated controller, a cabinet, detector amplifiers, and other associated equipment as listed below and on Standards 701316 and 701321 for each location specified. The Contractor shall have

available one spare controller and cabinet. The Contractor shall retain ownership of all traffic control equipment, miscellaneous accessories, and the installation methods shall be according to the following:

- a. **Traffic Signal Heads.** Two signal heads shall be provided for each mainline approach and for each sideroad within the designated work area. All signal faces shall have new lamps when installed. When the signals are not operating, the signal head shall be hooded according to Article 880.03 and the "SIGNAL AHEAD" sign covered or removed. The left signal head shall be mounted at a height of 3.1 m (10 ft) above the road surface measured to the bottom of the signal head. The right signal head shall be mounted at a height of 4.3 m (14 ft) above the road surface. Back plates will be required on all signals.

The right signal head shall be aimed so the centers of the light beams of the indications are directed toward a point in the center of the approach lane 150 m (500 ft) in advance of the signal. The left indication shall be aimed at a point in the center of the approach lane 30 m (100 ft) in advance of the stop line.

- b. **Lenses.** All lenses shall be 300 mm (12 in.) nominal diameter.
- c. **Wire and Cable.** The Contractor shall supply all overhead and underground wiring for both signal circuits and loop detector lead-ins. The electric cable shall be aerially suspended, at a minimum height of 2.5 m (8 ft) and as close to the right of way line as possible. When the electric cable crosses a roadway, or entrance it shall be aerially suspended, at a minimum height of 5.5 m (18 ft), according to the local utility requirements, or placed in a trench with a minimum of 50 mm (2 in.) of cover or protected in a manner approved by the Engineer.
- d. **Mounting.** The controller shall be mounted on a post, pole, or temporary concrete foundation. The signal heads shall be mounted on 7.5 m (25 ft) standard tubular steel posts or on a minimum Class 4 wood pole, when overhead wiring is used between signals. Alternative methods of mounting the cabinet or signal heads shall be approved by the Engineer. The supports shall be kept in a vertical position for the duration of the project.
- e. **Service Installation.** The Contractor shall be responsible for the installation and cost of 110 V electrical service. When the service cable from the controller to the power source is suspended overhead, the line height shall not be less than 2.5 m (8 ft) above the ground and located as close to the right of way lines as practicable. When the cable crosses a roadway or entrance, the cable shall be raised to a minimum height of 5.5 m (18 ft) or pass under the pavement through a culvert opening. Portable power generating equipment may be used for a short period of time until local power is available, provided at least one person is present at all times at the site to ensure proper operation.

## f. Traffic Signal Controller.

1. The controller shall be a standard eight phase NEMA controller housed in a weather proof cabinet. The traffic signals shall dwell in All-Red. The long all red intervals shall be adjustable up to 99 seconds in one second increments. Long all red intervals shall be obtained by using a trail green feature or an equivalent or by using dummy phases. The long all red interval shall be pre-empted if the previous movement is detected before the conflicting movement is detected and shall cause the previous movement to return to the green display with a minimum four second delay. When a conflict or failure is detected, the signal shall display a flashing All-Red. When an additional phase is used for a side road movement, only one long red interval shall be used between active phases on each side of the work area.

All devices used, in lieu of controller software to produce this sequence, shall be mounted within the cabinet but not within the controller. The Contractor shall provide an operational demonstration of the controller assembly for the Engineer subsequent to installation and prior to being placed into operation. The Contractor shall program the controller, trouble shoot, and correct any problems that arise, and verify the equipment is functioning according to the contract. If any controller malfunction occurs during the time of operation or in the event of a power failure, the Contractor shall, without delay, provide flaggers for traffic control and immediately install a replacement controller to operate the signals.

2. When specified, the Department will furnish the traffic actuated controller. The controller, complete with loop detector-amplifiers and pole mount cabinet, shall be picked up and returned upon completion of the project to the location designated on the plans. The Contractor shall provide notice to the Department at least two weeks in advance of requiring the traffic actuated controller. The Contractor shall be responsible for maintenance of the controller and all related equipment within the controller cabinet. The controller shall be inspected by the Contractor and Engineer subsequent to installation and prior to being placed into operation. Any malfunction of the Department owned equipment revealed during the inspection by the Contractor shall be repaired and will be paid for according to Article 109.04. The Contractor shall be responsible for any damage to the Department-owned equipment as a result of negligence or poor workmanship during installation at his/her expense. The Contractor shall provide all maintenance required, at his/her expense, to keep the Department-owned equipment functioning properly after being placed in operation.

- g. **Detector Loops.** Three detector loops shall be installed on each approach as shown on the plans. The near detector loops shall be placed 300 mm (12 in.) from the centerline and the far loop shall be placed 300 mm (12 in.) from the edge line. Each loop shall be connected to a separate detector amplifier channel. Call delay feature shall be used for the loops nearest the stop lines and defeated during the green of that phase. An alternate method of detection may be used if it has been demonstrated and approved by the Department.

The loop detector lead-in cable shall be protected from construction and maintenance activities. In the event of detector loop failure, the Contractor shall have 48 hours to repair or replace the loops. Upon completion of the project, the detector loop shall be terminated in such a manner as to provide for future use.

- (c) **Standard 701326.** No paving or excavating operations shall be performed at night unless authorized by the Engineer.
- (d) **Standard 701336.** Two flaggers shall be required for each separate construction operation. The flagger shall be a minimum of 60 m (200 ft) and a maximum distance of 1/2 day's operation beyond the flagger sign and a minimum of 30 m (100 ft) in advance of the work party.

Under restricted sight distance conditions, additional devices may also be required for distances less than 600 m (2000 ft) at the discretion of the Engineer.

During periods when workers are present all work areas shall be protected by cones or barricades along the centerline.

- (e) **Standard 701101.** When the work operation requires four or more work vehicles enter through traffic lanes in a one hour period, a flagger shall be provided and a "FLAGGER" sign shall be substituted for the "WORKER" sign. When the work operation is 4.5 m (15 ft) or more off the pavement edge, no signing or cones will be required, unless two or more vehicles cross the 4.5 m (15 ft) clear zone in one hour.
- (f) **Standard 701406 and 701401.**
  - (1) **General.** When Standard 701401 is specified for overnight operations, cones may be substituted for barricades or drums at half the spacing during day operations.
  - (2) **Multilane Pavement Resurfacing.** For the construction of binder course, surface course and shoulder resurfacing on multilane pavements, Standard 701406 or 701401 shall be used from the beginning of business on Monday to 4:30 p.m. on Friday. Only Standard 701406 may be used from 4:30 p.m. Friday to start of business on Monday.

- (3) Shoulder Upgrading and Replacement. The following shall apply to shoulder pipe underdrain installation and/or shoulder reconstruction on existing multilane divided highways.

The Contractor shall close the adjacent lane of pavement within the limits of the construction zone, when required by the Contractor's operations. When no workers are present and the difference in elevation between the pavement and the shoulder and/or widening is greater than 75 mm (3 in.), the Contractor shall place barricades according to Article 701.04(b).

During shoulder work on ramps, a minimum of two standard advance signs, a 1.2 m (48 in.) "RAMP CONSTRUCTION AHEAD", and a 1.2 m (48 in.) "FLAGGER AHEAD" or Flagger Symbol sign, and one flagger shall be used as directed by the Engineer. The work area shall be delineated by Type I or II barricades or vertical panels at 15 m (50 ft) spacings or closer if directed by the Engineer. Shoulder drop-offs greater than 40 mm (1 1/2 in.) caused by the Contractor's operations will be allowed only on one side of the ramp at a time. This work shall be included in the cost of Standard 701406 or 701401.

Standard 701401 will only be measured for payment where the average depth of shoulder reconstruction required by the plans, exclusive of any trench for pipe underdrain installation, is in excess of 75 mm (3 in.). Where such shoulder reconstruction is 75 mm (3 in.) or less, no open trench greater than 75 mm (3 in.) deep shall be permitted overnight. If, because of unforeseen circumstances, an open trench greater than 75 mm (3 in.) deep should occur overnight, the Contractor shall, at his/her own expense, close the adjacent traffic lane according to Standard 701401.

Excavations greater than 75 mm (3 in.) in depth between the pavement and shoulder, including any trenches within the shoulder area, shall be restricted to one shoulder in each direction of travel. In addition, shoulder drop-offs greater than 40 mm (1 1/2 in.) caused by the Contractor's operations will not be permitted over the winter shutdown.

The Contractor shall schedule the work so the lane closure at any one work area does not exceed five working days. The closure time may be exceeded for conditions beyond the Contractor's control, except if continual and persistent closures in excess of the five working days are made, the Engineer will initiate measures to delay or limit the daily production of the Contractor's operations.

All debris shall be removed from the shoulder and right of way prior to the removal of barricades, drums or vertical panels.

- (g) Standard 701416. Reflective solid edge lines and double yellow centerline shall be used when the closure time exceeds four days or when the normal posted speed outside the area of operations exceeds 80 km/h (50 mph). Reflectorized pavement marking tape shall be used for marking the edge lines and centerline on existing pavement. Either tape or reflectorized

pavement marking paint may be used for markings on the paved crossovers. Raised reflective pavement markers at 8 m (25 ft) centers shall also be installed under good weather conditions, for additional delineation.

When Standard 701416 is specified, the impact attenuator shall be positioned so as not to encroach onto the outer lane. Vertical panels may be attached to the concrete barriers where available space prohibits the use of drums.

When Standard 701416 is specified, vertical panels may be attached to concrete barriers where available space prohibits the use of drums.

- (h) Standard 701431. Reflective solid edge lines and a double yellow centerline shall be used when the closure time exceeds four days or when the normal posted speed outside the area of operations exceeds 50 mph. Reflectorized pavement marking tape shall be used for marking the centerline and edge lines on the existing pavement. Raised reflective pavement markers at 8 m (25 ft) centers shall be installed under good weather conditions to supplement the pavement marking tape. All existing pavement markings which conflict with the revised traffic pattern shall be removed.

Drums, or Type I or Type II barricades no greater than 600 mm (24 in.) wide, may be used in place of flexible delineators when the two-way operation is to be in place four days or less.

- (i) Standard 701426. Truck mounted attenuators will not be required for any vehicle traveling entirely on a completed shoulder.
- (j) Standard 701411. This Standard shall supplement mainline traffic controls for lane closures.

The channelizing devices shall clearly define a path for motorists entering or exiting the highway.

Reflectorized temporary pavement marking tape shall be placed throughout the barricaded area of each ramp where the closure time is greater than 14 days. Raised reflectorized pavement markers at 8 m (25 ft) centers may be used in lieu of tape where the pavement marking is to be placed adjacent to the barricades or drums.

- (k) Urban Traffic Control, Standards 701501, 701502, 701601, 701602, 701606, 701701, 701801.

- (1) General. "NO PARKING" signs shall be installed throughout the work area.

When the work area is in the parking lane and parking exists during work hours, "ROAD CONSTRUCTION AHEAD" or "ROAD WORK AHEAD" signs shall be installed 60 m (200 ft) in advance of the work area and the area shall be protected with cones or barricades.



Reflectorized temporary pavement marking tape shall be placed throughout the taper and along side the adjacent work area where the closure is greater than 14 days. The edge line shall be yellow for left lane closures.

- (2) Standard 701501. When Standard 701501 is specified on two-lane/two-way roadways, construction operations shall be confined to one traffic lane leaving the opposite lane open to traffic.
- (3) Standard 701606. When Standard 701606 is specified reflective pavement markings shall be used when the closure time exceeds four days. The double yellow center line shall be used in the two-way traffic area in addition to the barricades or drums. Single yellow left edge line shall be used to outline the barricade island. White right edge line shall be used along the barricades protecting the work area.
- (4) Standard 701801. On Standard 701801, where a temporary walkway encroaches on an existing parking lane, the lane shall be closed with cones, barricades, or drums.

Where a temporary walkway encroaches on a traveled lane, the lane shall be closed according to Standards 701501, 701606, or 701601.

All walkways shall be clearly identified, protected from motor vehicle traffic and free of any obstructions and hazards, such as holes, debris, construction equipment, and stored materials.

All hazards near or adjacent to walkways shall be clearly delineated.

When barricades are impractical to use or do not provide enough protection, orange safety fence shall be used to close off an area, with the approval of the Engineer.

#### **701.07 Method of Measurement.**

- (a) Not Measured. Traffic control and protection required under Standards 701001, 701006, 701011, 701101, 701106, 701301, 701311, and 701426 will not be measured for payment.
- (b) Standard 701401 will be measured for payment on an each basis only when the traffic control and protection applies to isolated stationary work areas and does not involve or is a part of other protected areas.

Where the contract work to be performed requires longitudinal movement of the work area, each subsequent installation of a Standard in a new location will be paid for according to Article 109.04. A contiguous lateral movement of the work area causing a change in the location of traffic control devices, but not a longitudinal relocation of the work area, will not be considered a new location or installation.

- (c) Measured As Lump Sum. Traffic control and protection required under Standards 701201, 701206, 701306, 701326, 701336, 701406, 701501,

701502, 701601, 701602, 701606, 701701 and 701801 will be measured for payment on a lump sum basis. Traffic control protection required under Standard 701401 will be measured for payment on a lump sum basis, except as specified under Article 701.07(b). Where the Contractor's operations result in daily changing, or two or more work areas each of which requires traffic control according to one of the above Standards, each work area installation will not be paid for separately, but shall be included in the lump sum price for the type of protection furnished.

- (d) Traffic Control Surveillance will be measured on a calendar day basis.
- (e) When constructing aggregate shoulders with bituminous resurfacing the cost of placing, compacting, maintaining, removing, and disposing of the temporary earth wedge will not be paid for directly, but shall be included in the contract unit prices for the construction items involved, and no additional compensation will be allowed.
- (f) Temporary rumble strips will be measured as each, where each is defined as an 8 m (25 ft) length installation.

**701.08 Basis of Payment.** The basis of payment for traffic control and protection will be as follows:

- (a) Traffic control and protection will be paid for at the contract unit price each for TRAFFIC CONTROL AND PROTECTION STANDARD 701316, TRAFFIC CONTROL AND PROTECTION STANDARD 701321, TRAFFIC CONTROL AND PROTECTION STANDARD 701331, TRAFFIC CONTROL AND PROTECTION STANDARD 701401, TRAFFIC CONTROL AND PROTECTION STANDARD 701402, TRAFFIC CONTROL AND PROTECTION STANDARD 701411, TRAFFIC CONTROL AND PROTECTION STANDARD 701416, TRAFFIC CONTROL AND PROTECTION STANDARD 701431 AT THE LOCATION SPECIFIED.

The replacement of any temporary pavement marking which has been in place for seven days or more will be paid for according to Article 109.04.

In the event the total value of the work items for which a traffic control Standard is required, is increased or decreased by more than ten percent, the unit price bid for that Standard will be adjusted as follows:

$$\text{Adjusted unit price} = .25P + .75P (1 \pm (X-0.1))$$

Where P is the bid unit price for the Standard

Where x =  $\frac{\text{Difference between original and final value of Work}}{\text{Original value of work requiring the use of the Standard}}$

Where (X – 0.1) is 0 if X is less than 0.1.

The value of the work items used in calculating the increase or decrease will include only items which have been added to or deducted from the contract under Article 104.02 and only items which require use of the Standard.

When the plans require multiple locations for the Standard and the Method of Measurement is on an each basis, the adjustment shall only be applied to the location(s) where added work is required.

- (b) Traffic control and protection indicated in Article 701.07(c) will be paid for at the contract lump sum price for TRAFFIC CONTROL AND PROTECTION
- |                     |                                |
|---------------------|--------------------------------|
| STANDARD 701201;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701206;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701306;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701326;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701336;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701401;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701406;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701501;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701502;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701601;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701602;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701606;    | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701701; or | TRAFFIC CONTROL AND PROTECTION |
| STANDARD 701801.    |                                |

Any alterations (additional or replacement of temporary pavement markings, or increases or decreases in work items by more than ten percent for which a traffic control standard is required) will be paid for according to Article 701.08(a).

- (c) Temporary signals required for Standards 701316 and 701321 will be paid for separately at the contract unit price each for TEMPORARY BRIDGE TRAFFIC SIGNALS.

When the Department furnishes the controller for Standards 701316 or 701321 the temporary bridge traffic signals will be paid for at the contract unit price each for TEMPORARY BRIDGE TRAFFIC SIGNALS (STATE FURNISHED CONTROLLER).

Any relocation of the traffic signal equipment due to stage construction changes will not be paid for separately, but shall be included in the cost of the initial installation.

- (d) Temporary concrete barrier and end sections will be measured and paid for according to Section 704.

Sand module impact attenuators and temporary bridge rail will be paid for separately. Temporary rumble strips will be paid for at the contract unit price each for TEMPORARY RUMBLE STRIPS.

- (e) Traffic Control Surveillance will be paid for at the contract unit price per calendar day or fraction thereof for TRAFFIC CONTROL SURVEILLANCE.

The cost of the materials for the maintenance of traffic control devices shall be included in the various control pay items.

- (f) Should the Engineer require additional signs, flaggers, barricades or other traffic control devices over and above those specified, they will be paid for according to Article 109.04.

When the Contractor requests a change in the traffic control, any additional flaggers required will be at the Contractor's expense.

**SECTION 702. WORK ZONE TRAFFIC CONTROL DEVICES**

**702.01 Description.** This work shall consist of furnishing, maintaining, and removing traffic control devices.

**702.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) Reflective Sheeting .....                | 1084.02         |
| (b) Construction and Maintenance Signs ..... | 1084.04         |

**702.03 Channeling Devices.**

- (a) General. Only the name and telephone number of the agency, Contractor, or supplier may be shown on the nonretroreflective surface of all channelizing devices. The letters and numbers shall be a nonretroreflective color and not over 50 mm (2 in.) in height.

Barricades, drums, cones, and/or vertical panels used for channelization or delineation along with warning signs shall be sequentially placed in the direction of the traffic flow and removed in reverse order. Lane closure and flagger signs shall be erected prior to barricades, drums, cones, and/or vertical panels and remain erected until all traffic control devices have been removed from the pavement.

All barricades, wing barricades, and vertical panels shall have alternating reflectorized white and reflectorized orange strips sloping downward at 45 degrees toward the side on which traffic will pass. Barricade stripes shall be 150 mm (6 in.) in width on barricades 900 mm (36 in.) or greater in length and 100 mm (4 in.) in width on barricades less than 900 mm (36 in.) in length. Type I and Type II Barricades shall be striped on both sides. Wing and Type III Barricades shall be striped on both sides where traffic approaches from either direction. Vertical panels placed on the outside of curves shall be striped on both sides. The predominant color for other barricade components shall be white, orange, or silver, except that galvanized metal or aluminum components may be used.

The lights on wing barricades, barricades, drums, or vertical panels shall be mounted above the top of the device to the side on which traffic will pass and shall not obscure any reflectorized portion of the device.

Cones, drums, and barricades shall not be mixed in individual runs of devices.

- (b) Barricades. Type 1 and 1A Barricades are for use on lower speed roads and shall not be used where normal posted speeds are greater than 40 mph unless the reflective area of the upper rail is at least 0.18 sq m (288 sq in.). Type I and Type II Barricades shall not be intermixed within an individual string of barricades. Type III barricades shall be used for road and lane closures.

Weights of concrete, stone, wood, or brick will not be allowed and all weights used to stabilize barricades, other than sandbags, must be rigidly attached to the legs of the barricades as close to the ground as possible. No sandbags will be allowed on the top rail of barricades. Sandbags may be placed on barricade legs, over striped bottom rails not facing traffic, over unstriped bottom rails, or suspended from the barricade rail or frame in such a manner so the bulk of the sand is at least 450 mm (18 in.) below the top of the barricade. Drums may be weighted internally with no more than enough sand or water to provide stability, or by other ballast system designed by the drum manufacturer and approved by the Department.

Barricade and wing barricade rails shall be no heavier than 25 mm (1 in.) thick lumber or plywood except for the sawhorse design Type 1A Barricade which may have a rail no heavier than 50 mm (2 in.) thick lumber. Other light weight weather resistant materials such as plastic, fiberglass, or sheet aluminum may be used. The face of the barricade rails may be sloping or vertical. Nominal lumber dimensions may be used to satisfy wooden barricade component dimensions.

For wing barricades, the optional back bracing on the wood or metal barricade may be used provided it attaches to the upright no higher than 300 mm (12 in.) above the bottom and if wood is used, the bracing shall be no heavier than 50 x 100 mm (2 x 4 in.) in size. Other light weight designs may be used with the approval of the Engineer.

Frames for Type I or Type II Barricades shall be designed to provide a stable support and should be constructed of light weight steel or aluminum angles, tubing, wood, plastic, or rubber and have no rigid stay bracing for "A" frame designs.

- (c) Vertical Panels. Vertical panels may be either post mounted, frame supported or attached to the top of a barrier. Post mounted vertical panels shall be firmly attached to light weight wood or metal posts with the top a minimum height of 1.2 m (4 ft) above the pavement surface. The frame and rail requirements for Type I and Type II barricades shall also apply to frame supported vertical panels. Frame supported vertical panels shall be used only where normal posted speeds are 40 mph or less with the top of the panel a minimum of 900 mm (36 in.) above the pavement.
- (d) Cones. Reflectorized cones are not required for day light operations, and shall only be used as specified on the plans or as approved by the Engineer.

When used, reflectorized cones shall have two white reflective bands. Cones shall be constructed of durable material able to withstand abuse by vehicular traffic. Minimum weights shall be 2 kg (4 lb) for 450 mm (18 in.), 3 kg (7 lb) for 700 mm (28 in.), and 5 kg (10 lb) for 900 mm (36 in.) cones with a minimum of 60 percent of the total weight in the base. Where posted speeds are greater than 40 mph cones shall be a minimum of 700 mm (28 in.) in height.

- (e) Drums. Drums shall be nonmetallic and have alternating reflectorized orange and reflectorized white horizontal, circumferential stripes. There shall be at least two orange and at least two white stripes on each drum. If nonreflective spaces are left between the orange and white stripes, they shall be no more than 50 mm (2 in.) in width. All nonreflectorized portions of the drums shall be orange. Drums may be slightly conical in shape and may have one or more flat surfaces to minimize rolling when hit. Drums shall have closed tops that shall prevent the collection of roadwork debris. Drums shall be weighted in a manner approved by the manufacturer so they are not moved by wind or traffic.

On construction projects where the ADT exceeds 25,000, plastic drums according to Standard 702001 with steady burning lights shall be used in lieu of Type I and Type II barricades throughout lane closures. They shall be placed at the location and spacing shown on the applicable traffic control standards.

Where plastic drums are specified, Type II barricades may be used in lieu of drums provided the barricades are made of plastic, fiberglass, or other nonmetallic materials, the top panels are 300 mm x 600 mm (12 x 24 in.); the bottom panels are 200 mm x 600 mm (8 x 24 in.), the orange and white reflective sheeting is Type A meeting the initial minimum coefficient of retroreflection in Article 1084.02, and all other requirements for Type II barricades are met. If flashing or steady burning lights are required for drums, this requirement shall be extended to the Type II barricades. Drums and Type II barricades shall not be intermixed within an individual taper or string of devices. This does not prohibit drums from being used in a taper section with Type II barricades being used in the tangent section, or vice versa.

- (f) Flexible Delineators. Flexible delineators shall be designed to bend under repeated impacts and return to an upright position without damage to the impacting vehicle or the delineators. They shall be attached to the pavement with adhesive meeting the recommendations of the delineator manufacturer. The use of studs will not be permitted without the approval of the Engineer.

The delineators shall be orange in color and have two reflectorized orange and two reflectorized white bands according to Article 1084.02.

The delineators shall be readily removable from the bases to permit field replacement. All missing or severely damaged delineators shall be replaced prior to suspension of work each working day and once each nonworking day on a schedule approved by the Engineer.

**702.04 Lights.** The Contractor shall be responsible for replacing lighting units that have become defective. The Contractor shall replace all light batteries on a group basis at such times as may be specified by the Engineer.

Lights will be required on barricades, drums, vertical panels, and signs according to the standards and as follows:

| CIRCUMSTANCE   | REQUIRED LIGHTING                        |
|--|--|
| Traffic Control Standard   | As shown on Standard                     |
| Special Detail in Plans  | As shown on Special Detail               |
| First two warning signs on each approach to the work involving a nighttime lane closure                  | Flashing lights during hours of darkness |
| Barricades or drums used in lieu of cones for night operations. (Does not apply to patching operations.) | Steady burn lights bi-directional lights |
| Obstacles, isolated hazards, or isolated excavations   | Flashing lights during hours of darkness |
| Obstacle, hazard, or excavation exceeding 100 ft in length. (Does not apply to widening operations)      | Steady burn bi-directional lights        |
| Drums and barricades for channelizing traffic.   | Steady burn bi-directional lights.       |
| Barricades and drums in tapers   | Steady burn mono-directional lights      |
| Barricades in widening trench  | No lights required                       |
| Drums and barricades on projects with an ADT exceeding 25,000  | Steady burn mono-directional lights      |
| Drums and barricades protecting patches on projects with an ADT less than 25,000                         | No lights required                       |
| Drums and barricades protecting patches on projects with an ADT exceeding 25,000                         | Steady burn mono-directional lights      |
| Construction speed limit sign  | According to Article 702.05c.            |

Barricades or drums with lights shall be used in lieu of cones for night operations. Lights are not required on drums or barricades for day operations. Drums or barricades utilized to protect obstacles, hazards, or excavations at night shall have flashing lights. If the protected area exceeds 30 m (100 ft) in length, steady burning lights shall be substituted for flashing lights. Drums and barricades for channelizing

traffic and tapers shall have steady burning lights. All barricade lights shall be bi-directional except lights on taper barricades, which shall be monodirectional.

### **702.05 Signs.**

- (a) General. Sign posts shall be either wood or metal. Wood sign posts shall be according to Articles 1007.12 and 1093.01 except the size shall be 100 x 100 mm (4 x 4 in.). Metal sign posts shall be according to Section 1006. Galvanizing of metal posts will not be required. Alternate designs and or materials may be permitted when approved by the Engineer.

Signs on temporary supports shall be within 20 degrees of a vertical position. Weights of concrete, stone, or brick will not be allowed and all weights used to stabilize signs other than sandbags must be rigidly attached to the sign support as close to the ground as possible.

Post mounted signs shall be erected and maintained within five degrees of a vertical position. Two posts shall be used for signs greater than 1.5 sq m (16 sq ft) in area or where the height between the sign and the ground exceeds 2.1 m (7 ft). Bracing no heavier than 50 x 100 mm (2 x 4 in.) wood may be used for added support. Any brace placed parallel to the road shall be sloped down toward approaching traffic.

When approved by the Engineer, skids may be used to support signs where posts are impractical. They shall not exceed the structural design of Type III barricades and shall be no greater than 1.2 m (4 ft) in length.

Where construction operations result in a temporary drop-off at the edge of a completed stabilized shoulder and the road has a posted speed limit of 55 mph or greater and is open to traffic, "SHOULDER DROP-OFF" (W21-I103) signs shall be used. The Contractor shall place the signs at the beginning of the dropoff area, just beyond freeway interchanges or major intersections on nonfreeways, and at such other locations within the dropoff area as the Engineer may direct to ensure a nominal spacing of 3 km (2 miles). The signs shall be placed just prior to the work which will result in the drop-off and shall remain in place until the drop-off is eliminated. This work shall be considered as included in the contract unit prices for the construction items involved and no additional compensation will be allowed.

When work operations exceed four days, all signs shall be post mounted unless the signs are located on the pavement or defining a moving or intermittent operation. Signs located on the pavement shall be skid mounted. Longitudinal dimensions shown on the plans for the placement of signs may be increased up to 30 m (100 ft) in order to avoid obstacles, hazards, or to improve sight distance, when approved by the Engineer. "ROAD CONSTRUCTION AHEAD" signs will also be required on the side roads located within the limits of the mainline "ROAD CONSTRUCTION AHEAD" signs.

- (b) Arrow Boards. On roads with speeds of 45 mph and above, Type C units shall be used for all operations 24 hours or more in duration, and Type B units may be used for operations less than 24 hours in duration. Type A, B,



or C units may be used for all operations on roads with speeds less than 45 mph. Arrow boards shall not be used to direct passing moves into lanes used by opposing traffic or to shift traffic without having a lane change.

- (c) Construction Speed Limit Sign. The sign assembly shall be trailer mounted according to Article 1106.04. All signs shall be reflectorized meeting the requirements of Article 1084.02. The signs may be combined on a single panel.

The flashing lights for the Construction Speed Limit signs shall feature monodirectional amber lenses with reflectors and shall be visible through a range of 120 degrees when viewed facing the sign. The light shall be either strobe, halogen, or incandescent lamps, be visible for a minimum distance of 1.6 km (1 mile), and have a minimum flash rate of 40 per minute. A small flashing "on" indicator light shall be provided on the back of the sign visible for 150 m (500 ft) to provide confirmation to workers the light is operating. The lights shall operate on either full battery power with solar panel charging (capable of maintaining a charged battery level) and 135 A, 12 V deep cycle battery(s), or a gasoline or diesel powered generator with a maximum fuel capacity of 95 L (25 gal).

- (d) Work Zone Speed Limit Signing.

- (1) Multi-lane Work Zone Speed Limit. Sign assemblies consisting of a 0.9 x 1.2 m (36 x 48 in.) "SPEED LIMIT" 10 mph less than the posted speed, but not less than 55 mph and 0.9 x 0.9 m (36 x 36 in.) "WORK ZONE" sign shall be located, one on each shoulder 150 m (500 ft) before the start of the lane tapers for lane closures on multi-lane roadways. Two additional assemblies shall be placed 150 m (500 ft) beyond the last entrance ramp for each interchange. Sign trailers may be utilized for signs for moving operations and skids may be utilized for signs on projects where work operations will last three days or less. For all other projects these signs shall be post mounted using two wood or metal posts and installed as shown on Standard 702001. All existing "SPEED LIMIT" signs located within the work zone shall be removed or covered. This work shall be coordinated with the lane closure(s) by promptly establishing a reduced posted speed zone when the lane closure(s) are put into effect and promptly reinstating the posted speed zone when the lane closure(s) are removed.

One 750 mm x 1.2 m (30 x 48 in.) "END WORK ZONE SPEED LIMIT" sign shall be located at the end of the lane closure. If the lane closure terminates at the end of the project, then this sign replaces the "END CONSTRUCTION" sign, if it is required.

- (2) Construction Speed Limit Signing. Two sign assemblies shall be located one on each shoulder for multi-lane roadways where the median is at least 3 m (10 ft) wide. When specified on other roadways, one device will be required on the right shoulder for each direction of traffic. Additional assembly(s) shall be placed 150 m (500 ft) beyond the last entrance ramp for each interchange and at each side road(s).

One of these sign assemblies shall be positioned adjacent to the closed lane at a distance of 150 m (500 ft) minimum to 750 m (2500 ft) maximum in advance of any worker(s) throughout the length of the lane closure and as directed by the Engineer. The signs shall be installed on trailers according to Article 1106.04. Care should be used in adjusting the position of these signs in relation to other signs and devices. The sign locations are approximate and should be adjusted to allow approximately 150 m (500 ft) spacings between these signs and other signs. They should be positioned in such a manner that all motorists approaching a worker(s) shall have an unobstructed view of one or more of these signs.

The speed limit shown shall be 10 mph below the posted or work zone speed limit.

When the Construction Speed Limit sign assembly is used, the "END WORK ZONE SPEED LIMIT" sign shall be erected at the end of the lane closure. If the lane closure terminates at the end of project, then the "END WORK ZONE SPEED LIMIT" sign replaces the "END CONSTRUCTION" sign, if it is required.

The flashing lights shall be activated only when workers are present in a closed lane adjacent to one open to traffic and as directed by the Engineer. At all other times, the lights shall be turned off and the Construction Speed Limit sign assembly shall be promptly removed or covered. When both the Work Zone and Construction Speed Limit signs are no longer in effect the "END WORK ZONE SPEED LIMIT" sign shall be removed or covered and the posted speed shall be promptly reinstated.

The Construction Speed Limit sign assemblies will not be required when the worker(s) are located behind a concrete barrier wall.

- (e) Flagger Traffic Control Paddle. This sign shall be used by the flagger in lieu of flags or other signaling devices. The "STOP" face shall consist of white letters and border on a red retroreflectorized background. The "SLOW" face shall consist of black letters and border on a fluorescent orange retroreflectorized background. All reflective faces shall be fabricated with sheeting according to Article 1084.02. Areas outside sign borders shall be light blue or black. The portion of the staff within the sign face shall match the sign colors. All colors and letters shall meet applicable federal standards.

The staff shall consist of two sections joined by a coupling located 1.5 m (5 ft) from the bottom of the staff.

**702.06 Basis of Payment.** This work will not be paid for separately but shall be considered as included in the cost of the traffic control and protection specified in Section 701.

**SECTION 703. WORK ZONE PAVEMENT MARKING**

**703.01 Description.** This work shall consist of furnishing, installing, maintaining, and removing short term and temporary pavement markings.

**703.02 Materials.** Materials shall be according to the following Articles in Section 1000 - Materials:

| Item                                | Article/Section |
|-------------------------------------|-----------------|
| (a) Pavement Marking Tape .....     | 1095.06         |
| (b) Painted Pavement Markings ..... | 1095.02         |

**CONSTRUCTION REQUIREMENTS**

**703.03 General.** Short term pavement markings shall consist of abbreviated patterns for edge, lane and centerline markings. Within a specified time limit, short term pavement markings shall either be resurfaced or replaced with the full pavement marking patterns indicated on the plans with either a temporary material paid for as temporary pavement marking or with permanent material. Within the conditions as specified, the Contractor may be required to place all or a part of the quantities shown on the plans for short term pavement markings and temporary pavement markings.

The surface to which the pavement marking is to be applied shall be clean and dry. Pavement marking tape shall be applied to the prepared surface according to the manufacturer's recommendations or by a method approved by the Engineer. Painted lines shall be installed according to Section 780 except hand-operated strippers may be used for all applications of short term and temporary pavement marking.

**703.04 Short Term Pavement Markings.** Before the lane is opened to traffic, appropriate Short Term Pavement Markings shall be installed between all lanes open to traffic. Centerline or lane line markings shall consist of an abbreviated pattern of single stripes 1.2 m (4 ft) in length and a minimum of 100 mm (4 in.) wide at a maximum spacing of 12 m (40 ft) between stripes. Centerlines on two-lane highways shall be yellow and lane lines separating two or more lanes of traffic moving in the same direction shall be white. Edge line markings shall consist of 1.2 m (4 ft) stripes on 30 m (100 ft) centers installed at approximately a four degree diagonal pointing in the direction of traffic. Edge line markings will only be required on multilane divided highways and other highways with a paved shoulder greater than 1.2 m (4 ft) wide. Markings on the final wearing surface shall be transversely offset from the permanent pavement marking location as directed by the Engineer. Markings shall be removed within five days after the permanent pavement markings are installed.

The short term pavement markings shall be replaced with the required full standard pavement markings consisting of either temporary or permanent pavement marking as soon as possible. Except as indicated below, temporary pavement marking or the permanent pavement markings shall be installed for no passing zones within three calendar days and for all other markings within 14 calendar days, respectively, after the completion of any intermediate or final surface treatment. This time restriction shall begin at the completion of each intermediate or final lift on resurfacing projects.

If the existing markings are obliterated by milling or any other surface treatment, the time restriction shall begin when the entire surface has been treated. These restrictions may be delayed by the Engineer whenever the Contractor cannot apply pavement markings due to unanticipated inclement weather (other than winter shutdown on the project), strike activities, or other circumstances beyond the Contractor's control as determined by the Engineer. In these cases, the required full standard temporary or permanent markings shall be installed as soon as construction activities are resumed. Prior to winter shutdown, standard edge lines, lane lines, centerlines, no passing zones, and any other necessary markings as determined by the Engineer shall be installed on any intermediate or final surface remaining open to traffic during the winter shutdown period.

**703.05 Temporary Pavement Marking.** When any intermediate course cannot be overlaid or if the final surface cannot be permanently marked within the time restrictions listed above, the full standard markings shall be installed with temporary pavement marking. The temporary markings shall be of the same color and dimensions as shown on the plans for the permanent markings, or as directed by the Engineer.

Type I or Type II marking tape or paint shall be used at the option of the Contractor, except paint shall not be applied to the final wearing surface unless authorized by the Engineer for late season applications where tape adhesion would be a problem. Type III marking tape shall be used on the final wearing surface when the temporary pavement marking will conflict with the permanent pavement marking such as on tapers, crossovers and lane shifts.

Except during winter shutdown periods, temporary pavement marking showing deterioration for any reason within seven days after placement, shall be replaced by the Contractor at his/her own expense. Temporary pavement markings which are in conflict with subsequently established pavement markings, or which interfere with the permanent pavement markings, shall be removed. Marking tape or paint placed on the final wearing course shall be transversely offset from the permanent pavement marking planned location as directed by the Engineer. All remaining temporary pavement marking tape or paint shall be removed within five working days after placement of the permanent pavement marking. When edge lines or channelizing lines are required, they shall be continuous. When continuous sections of tape are used, they shall be cut completely through at intervals of approximately 8 m (25 ft).

Instead of pavement markings, no passing zones on two-lane and three-lane roads may be identified by either the pennant "NO PASSING ZONE" warning sign or both the "DO NOT PASS" and "PASS WITH CARE" regulatory signs in conjunction with Short-Term Markings for periods of time up to three calendar days after an intermediate or final lift is completed on resurfacing projects.

These signs may also be used in lieu of pavement markings on low volume roads until it is practical and possible to install the permanent pavement markings.

If, in the traffic control plan, the road is specified as low volume, it is exempt from the requirements regarding no-passing zone pavement markings.

**703.06 Method of Measurement.** Short term pavement markings and temporary pavement markings of the various line widths will be measured for payment in meters (feet) in place and accepted. Double yellow lines will be measured as two separate lines.

The replacement of temporary pavement markings of the various line widths during winter shutdown periods will be measured for payment in meters (feet) as specified above, except only those pavement markings directed by the Engineer to be replaced will be measured for payment.

Letters and symbols used in conjunction with temporary pavement marking conforming to the sizes and dimensions specified will be measured for payment in square meters (square feet) according to the areas listed in Table 1, Section 780.

Short term and temporary pavement marking removal will be measured in square meters (square feet).

**703.07 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for SHORT TERM PAVEMENT MARKING or for TEMPORARY PAVEMENT MARKING of the line width specified, and at the contract unit price per square meter (square foot) for TEMPORARY PAVEMENT MARKING LETTERS AND SYMBOLS. Removal will be paid for at the contract unit price per square meter (square foot) for WORK ZONE PAVEMENT MARKING REMOVAL.

When temporary pavement marking is shown on the Standard, the cost of the temporary pavement marking will be included in the cost of the Standard.

When Pavement Marking Tape, Type III is specified in the contract other than on a Standard, the work will be paid for at the contract unit price per meter (foot) for PAVEMENT MARKING TAPE, TYPE III of the line width specified and at the contract unit price per square meter (square feet) for PAVEMENT MARKING TAPE, TYPE III - LETTERS AND SYMBOLS.

## SECTION 704. TEMPORARY CONCRETE BARRIER

**704.01 Description.** This work shall consist of furnishing, placing, maintaining, relocating and removing precast concrete barriers at temporary locations as shown on the plans or as directed by the Engineer.

**704.02 Materials.** All materials shall be according to the following Articles of Section 1000 - Materials.

| Item                                  | Article/Section |
|---------------------------------------|-----------------|
| (a) Portland Cement .....             | 1020            |
| (b) Reinforcement Bars .....          | 1006.10         |
| (c) Welded Wire Fabric (Note 1) ..... | 1006.10         |

Note 1. Welded wire fabric shall be 150 mm x 150 mm, 5.7 mm diameter (6 in. x 6 in. , W4 x W4) weighing approximately 2.8 kg/sq m (58 lb/100 sq ft).

## CONSTRUCTION REQUIREMENTS

**704.03 General.** Precast barrier units shall be constructed according to the applicable portions of Sections 504 and 1020. Precast units shall not be removed from the casting beds until a flexural strength of 2,000 kPa (300 psi) or a compressive strength of 10,000 kPa (1400 psi) is attained. Transportation of precast sections to the jobsite will not be allowed until a flexural strength of not less 4,500 kPa (650 psi) or a compressive strength of not less than 24,000 kPa (3500 psi) is attained. In no case may precast units be loaded, shipped, and used prior to four days after casting.

The wall units shall be reinforced with either deformed bar reinforcement or welded wire fabric according to the details shown on the plans. The inserts for M12 (1/2 in.) bolts shall be capable of 13 kN (3000 lb) pull-out strength and shall be furnished with a galvanized bolt and washer.

The Contractor shall have the option of furnishing the barrier units with or without the longitudinal keyway.

The temporary barriers shall be removed when no longer required by the contract.

**704.04 Barrier Markings.** Each unit of precast barrier shall be clearly marked with the name or trademark of the manufacturer, the Illinois Department of Transportation standard and subscript number (i.e. 704001- ) and the date of manufacture. If the manufacturer has more than one plant, the plant identification shall also be included. The markings shall be indented on the barrier section or painted thereon with waterproof paint.

**704.05 Configuration.** Precast units which have the New Jersey configuration and which have previously been cast meeting earlier Department standards, may be used. The units shall be in good condition, without cracks or spalls, and the connection devices shall not be broken. The Contractor will be allowed to mix barrier units of previous designs in the same run with new units, provided the connection devices are compatible and the units are of the same width so a smooth, continuous face can be obtained. Connection devices other than those shown on the plans may be used with the approval of the Department.

Units of other designs from other agencies having the New Jersey configuration may be used with the approval of the Engineer. The Contractor will be required to furnish a certification signed by a responsible official of the outside agency stating the barrier design is currently acceptable and has been inspected and approved by them.

**704.06 Installation.** Barrier units shall only be installed to deflect traffic. Gaps in the barrier shall not be permitted. Barrier shall remain in place until the hazard no longer exists, and then should be removed completely. Each successive set of barriers shall be equipped with tapers for each direction of approaching traffic.

Barrier units shall be placed and pinned together in a continuous smooth line at the exact locations provided by the Engineer. The connecting pin for the pin and loop connection, may be either a plain 22 mm (7/8 in.) diameter or a deformed No. 25

(No. 7) bar meeting the requirements of Article 1006.10(b) except Grade 400 (Grade 60) bars shall be used.

Barrier units or attachments damaged during transportation or handling, or by traffic during the life of the installation, shall be repaired or replaced by the Contractor at his/her expense. The Engineer will be the sole judge in determining which units or attachments require repair or replacement.

The barrier units shall be seated with styrofoam pads except when specified in the plans to be secured with dowel bars. The dowel bars shall be 25 mm (1 in.) in diameter, at least 300 mm (12 in.) long, shall be embedded at least 200 mm (8 in.) into the underlying roadway structure and shall not project above the outer surface of the barrier. After dowel bar removal, all holes in the roadway structure shall be filled with a material approved by the Engineer.

When the temporary concrete barrier terminal section is used it shall be secured to the underlying roadway structure with a drift pin. The hex nut on the drift pin shall be threaded half way onto the pin and tack welded, or coupling nut tightened sufficiently to prevent loosening may be used. The nut shall then be filled with grease to exclude contaminants. After drift pin removal, the hole in the roadway structure shall be filled with a material approved by the Engineer.

When temporary concrete barriers are to be relocated, the units shall be removed from the old location, transported to the new location, and reinstalled as previously specified.

**704.07 Method of Measurement.** Temporary concrete barrier will be measured for payment in meters (feet) in place along the centerline of the barrier. Terminal sections will be measured as units of each. When stage construction requires barriers to be relocated within the limits of the jobsite, the relocated temporary concrete barrier, including terminal sections, will be measured for payment in meters (feet) in place along the centerline of the barrier and terminal sections.

**704.08 Basis of Payment.** When the Contractor furnishes the barrier units, this work will be paid for at the contract unit price per meter (foot) for TEMPORARY CONCRETE BARRIER or RELOCATE TEMPORARY CONCRETE BARRIER and at the contract unit price each for TEMPORARY CONCRETE BARRIER TERMINAL SECTION.

When the Department furnishes the barrier units, this work will be paid for at the contract unit price per meter (foot) for TEMPORARY CONCRETE BARRIER, STATE OWNED or RELOCATE TEMPORARY CONCRETE BARRIER, STATE OWNED, and at the contract unit price each for TEMPORARY CONCRETE BARRIER TERMINAL SECTION, STATE OWNED.

## **SECTION 705. TEMPORARY STEEL PLATE BEAM GUARDRAIL**

**705.01 Description.** This work shall consist of furnishing, erecting, maintaining, and removing steel plate beam guardrail, including posts and traffic barrier terminals.

**705.02 Materials.** Materials shall be according to the following Articles in Section 1000 - Materials:

| Item  | Article/Section           |
|---|---------------------------|
| (a) Rail Element Plates, End Section Plates, and Splice Plates.....       | 1006.25                   |
| (b) Bolts, Nuts, Washers and Hardware .....                               | 1006.25                   |
| (c) Wood Posts and Wood Block .....                                       | 1007.01, 1007.02, 1007.06 |
| (d) Steel Posts, Blockouts, Restraints, and Wire Rope for Guardrail ..... | 1006.04                   |
| (e) Preservative Treatment .....  | 1007.12                   |
| (f) Hollow Structural Tubing .....  | 1006.27(b)                |

**CONSTRUCTION REQUIREMENTS**

**705.03 General.** Construction of the temporary steel plate beam guardrail and temporary traffic barrier terminals shall be according to the applicable requirements of Sections 630 and 631, respectively.

The guardrail shall be removed after use and shall become the property of the Contractor.

**705.04 Method of Measurement.** Temporary steel plate beam guardrail will be measured for payment in meters (feet). The length measured will be the overall length of rail erected, measured along the top edge of the rail elements to the limits shown on the plans.

The various types of temporary traffic barrier terminals will be measured for payment complete in place in units of each. The pay limit between the terminal and the adjacent guardrail shall be as shown on the plans.

**705.05 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for TEMPORARY STEEL PLATE BEAM GUARDRAIL of the type specified and at the contract unit price each for TEMPORARY TRAFFIC BARRIER TERMINAL of the type specified. The Contractor, in preparing his/her bid prices shall take into consideration the salvage value of the removed materials.

**SIGNING**

**SECTION 720. SIGN PANELS AND APPURTENANCES**

**720.01 Description.** This work shall consist of furnishing, fabricating, and/or installing sign panels, complete with sign faces, legend, and supplemental panels.

**720.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials

| Item   | Article/Section |
|--|-----------------|
| (a) Sign Base .....                            | 1090            |
| (b) Sign Face .....                            | 1091            |
| (c) Sign Legends and Supplemental Panels ..... | 1092            |



The sign mounting support channel shall be manufactured from steel or aluminum.

Steel support channels shall be according to ASTM A 5.25 (mild strip) and Standard 720001 and shall be galvanized. Galvanizing shall be according to ASTM A 525, Coating Designation 90 when galvanized before forming and AASHTO M 232, Class B 2 when galvanized after forming.

Aluminum support channels shall be according to ASTM B 308M, Alloy 6061-T6 or ASTM B 221M, Alloy 6063-T6.

The stainless steel banding for mounting signs or sign support channels to light or signal standards shall be according to ASTM A 167 Type 302B, Grade 18-8 stainless steel.

**720.03 General.** The three types of individual panels are defined by surface area according to the following descriptions:

Type 1 - 0.84 sq m (9 sq ft)

Type 2 Over 0.84 sq m (9 sq ft) and less than 2.2 sq m (24 sq ft)

Type 3 - 2.2 sq m (24 sq ft)

The surface area is determined by calculating the area of the smallest rectangle, measured from edge-to-edge (horizontally and vertically), that will circumscribe an individual sign, except in the case of a triangular sign. The area of a triangular sign shall be the net triangular area.

A sign panel assembly is composed of one or more sign panels mounted individually or as a group. The two types of sign panel assemblies are defined by the total surface area of the individual sign panels according to the following descriptions:

Type A Assemblies are composed of Type 1 sign panels with a total sign panel area of 0.84 sq m (9 sq ft) or less.

Type B Assemblies are composed of Type 1 or Type 2 sign panels with a total sign panel area over 0.84 sq m (9 sq ft).

Where any sign legend dimensions shown in the plans conflict with the sign legend manufacturer's recommendations, the dimensions shown in the plans or as determined by the Engineer shall govern.

The backs of all sign panels shall be metal stamped, engraved, etched, or otherwise marked in a manner designed to last as long as the sign face material, in letters and numerals at least 9.5 mm (3/8 in.) but no more than 19 mm (3/4 in.) in height with the month and year of manufacture, the name of the sign manufacturer, and the initials IDOT.

When standard signs designated by letters and numbers are to be furnished, they shall be according to the MUTCD. Detailed drawings of signs with an "I"

preceding the sign designation code are available from the Engineer of Operations. Detailed drawings of all other standard signs are available from the Federal Highway Administration (HTO-20), Washington, D.C. 20590.

## CONSTRUCTION REQUIREMENTS

**720.04 Installation.** Sign panels shall be installed using all required supporting channels and mounting hardware specified.

All sheet aluminum sign panels and supporting panels shall be mounted to the sign posts or supporting channels with M8 (5/16 in.) stainless steel, zinc, or cadmium plated steel hex head bolts with lock nuts. For design panels 0.84 sq m (9 sq ft) or greater in area, flat steel fender washers shall be placed next to the bolt head and the nut. A 3 mm (1/8 in.) thick nylon washer shall be placed between the metal washer and the sign face. For sign panels less than 0.84 sq m (9 sq ft) in area, standard steel flat washer shall be placed next to the bolt head and nut. A nylon washer shall be placed between the metal washer and the sign face.

Supporting channels shall be used to brace sign panels mounted permanently on:

- (a) Single posts when the sign width is greater than 900 mm (36 in.).
- (b) More than one post when the distance between the posts is greater than 1.2 m (4 ft).

Horizontal supporting channels used to brace individual signs shall be located using the mounting holes prepunched in the sign blank.

All bolts and nuts shall have National Coarse Thread (UNC).

When a Type 2 panel is to be installed above or below a Type 3 panel, all materials shall be the same as those used for the Type 3 panel. The Contractor shall use the same type of sign base material and sign legend throughout this work.

When the plans require auxiliary sign panels or route shields to be installed on a Type 3 sign panel, they shall be fabricated using a sign base according to Article 1090.01 and a sign face according to Article 1091.01.

**720.05 Method of Measurement.** Sign panels will be measured for payment in square meters (square feet) according to Article 720.03.

**720.06 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square foot) for SIGN PANEL, of the type specified.

## SECTION 721. SIGN PANEL OVERLAY

**721.01 Description.** This work shall consist of furnishing, and installing sign panel overlays, complete with reflectorized or nonreflectorized sign face and legend, on existing sign panels.

**721.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item                              | Article/Section |
|-----------------------------------|-----------------|
| (a) Sign Base .....               | 1090            |
| (b) Sign Face (Note 1) .....      | 1091            |
| (c) Sign Legends (Note 2) .....   | 1092            |
| (d) Overlay Panels (Note 3) ..... | 1090.02         |

- Note 1. The sign face shall be Type A.
- Note 2. The legend shall be Type A except when black in color.
- Note 3. The overlay panels shall be 2 mm (0.08 in.) thick.

**CONSTRUCTION REQUIREMENTS**

**721.03 General.** The existing sign shall be stripped off the sign legend, and the sign panel overlay and new legend shall be installed on the existing sign base. Ground-mounted sign panels may be taken down or the required work may be done in place. Any sign panel which is removed for overlaying shall be rigidly braced on the backside so the panel shall not flex and damage the overlay while being reinstalled.

The existing legend shall be completely removed, leaving no rivets protruding from the surface of the panel. The overlay shall be applied in vertical panels not more than 1200 mm (48 in.) nor less than 600 mm (24 in.) in width.

Adjacent panels shall be butt-joined with the spaces between joints 2.5 mm (0.10 in.) or less in width. No horizontal joints shall be used except on sign panels over 3.6 m (12 ft) in height.

The panels shall be securely fastened to the sign with 4.75 mm (3/16 in.) aluminum dome head rivets with aluminum mandrels. All rivets shall be matched to the color of the overlay panel being installed. The rivets shall be placed at 300 mm (12 in.) centers or less along all four edges and in a vertical row down the center of the panel at 600 mm (24 in.) centers or less. The rivets shall be approximately 6 mm (1/4 in.) in from open edges. All rivets shall be placed in the area of the aluminum extrusion panel ridge to prevent dimples in the sign panel overlay.

The sign sizes and legend sizes shown in the plans shall be verified in the field by the Contractor. The Department assumes no responsibility for the accuracy of these measurements. The replacement legend shall be the same size and shall be spaced the same as the existing sign. The Contractor shall be responsible for the correct spacing of any revised legend according to the general freeway signing practices.

Individual signs shall not be out of service for longer than 24 consecutive hours, subject to the following conditions and exceptions:

## Art. 722.01 Demountable Sign Legend Characters and Arrows

- (a) No more than one advance guide sign of the sequence of signs on an approach to an interchange shall be out of service at any given time. (These signs are labeled "A" in the plans.)
- (b) Signs labeled "B" may be out of service at the same time as any other signs.
- (c) Signs labeled "C" are considered critical and shall be out of service no more than six consecutive hours and shall not be out of service when any "A" sign for the approach is also out of service.

**721.04 Method of Measurement.** The sign panel overlay will be measured for payment in square meters (square feet). The area used for measurement shall be the actual area of the sign panel overlay.

**721.05 Basis of Payment.** This work will be paid for at the contract unit price per square meters (square feet) for SIGN PANEL OVERLAY. Replacement of any sign panel hardware broken during removal of a sign panel will be included in the cost of this item.

## SECTION 722. DEMOUNTABLE SIGN LEGEND CHARACTERS AND ARROWS

**722.01 Description.** This work shall consist of furnishing demountable legend characters, arrows, symbols, and route shields and installing them on existing sign panels.

**722.02 Materials.** Materials shall meet the requirements for sign legend specified for Type 3 sign panels, in Table 1 of Section 1092.

## CONSTRUCTION REQUIREMENTS

**722.03 General.** Each demountable legend unit shall be securely fastened to a previously prepared sign panel.

**722.04 Basis of Payment.** Demountable sign legend characters, arrows, symbols, and route shields will be paid for at the contract unit price each for DEMOUNTABLE LEGEND CHARACTERS AND ARROWS of the sizes specified.

No extra compensation will be allowed for borders, diagonals, periods, commas, hyphens, or apostrophe. Auxiliary panels will be paid for according to Article 721.05.

## SECTION 723. INSTALL EXISTING SIGN PANEL

**723.01 Description.** This work shall consist of installing an existing sign panel on a previously erected sign support(s) or sign structure.

**CONSTRUCTION REQUIREMENTS**

**723.02 General.** The existing sign panel shall be transported by the Contractor to the location specified in the contract and installed on the previously erected sign support(s) or sign structure according to the details shown in the plans or as directed by the Engineer.

**723.03 Method of Measurement.** This work will be measured for payment in square meters (square feet) according to Article 720.03.

**723.04 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square foot) for INSTALL EXISTING SIGN PANEL.

**SECTION 724. REMOVE, REPLACE AND RELOCATE SIGN PANEL  
AND SIGN PANEL ASSEMBLY**

**724.01 Description.** This work shall consist of removing, relocating, and/or replacing sign panels and sign panel assemblies with their supports.

**724.02 Backfill.** All holes left from the removal of supports shall be backfilled with suitable material approved by the Engineer. The surface of the filled hole shall be treated to match the surrounding area.

**724.03 Removal.**

- (a) Sign Panel Assembly. The sign panel assembly shall be removed from the posts, the supporting channels and the entire support(s) shall be completely removed, and all items transported to the location specified in the contract. When the existing sign panel assembly to be removed is to be replaced by a new sign panel assembly, the new assembly shall be completely installed prior to removal of the existing assembly. Duplicate assemblies shall not exist for periods in excess of 24 hours
- (b) Sign Panels. The sign panel shall be removed completely, including all hardware, and transported to the location specified in the contract.

**724.04 Relocate.**

- (a) Sign Panel Assembly. The sign panel assembly and supporting channels shall be installed or reinstalled on new sign supports using new mounting hardware according to the details shown in the plans. In no case shall the time between the removal of an existing sign panel assembly and its reinstallation be in excess of 45 minutes.
- (b) Sign Panel. The sign panel shall be installed or reinstalled on previously erected sign supports or a sign structure using new mounting hardware according to the details shown in the plans or as directed by the Engineer. Any new sign support brackets or redrilling of existing brackets shall be provided when necessary. In no case shall the time between the removal of an existing sign panel and its reinstallation be in excess of two hours, unless authorized in writing by the Engineer.

**724.05 State Furnished Signs.** When signs are specified to be furnished on the project by the State, the signs will be made available to the Contractor's office upon written request. These signs will be delivered within one week of request and, upon delivery, will become the responsibility of the Contractor.

**724.06 Method of Measurement.** Sign Panel removal, replacement, and relocating will be measured in square meters (square feet) according to Article 720.03.

**724.07 Basis of Payment.** This work will be paid for at the contract unit price each for REMOVE SIGN PANEL ASSEMBLY of the type specified or per square meter (square foot) for REMOVE SIGN PANEL of the type specified. When the contract specifies remove and replace the work shall be considered relocation and will be paid for at the contract unit price each for RELOCATE SIGN PANEL ASSEMBLY of the type specified or per square meter (square foot) for RELOCATE SIGN PANEL of the type specified.

**SECTION 725. OBJECT MARKER**

**725.01 Description.** This work shall consist of furnishing and installing an object marker Type 1, Type 2, or Type 3 on a previously erected support.

**725.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) Acrylic Plastic Prismatic Center-Mount Reflectors (Note 1) ..... | 1097.03         |
| (b) Sign Base .....  | 1090            |
| (c) Sign Face .....  | 1091            |

Note 1. Used on Type 1 or Type 2 object markers.

**725.03 Basis of Payment.** This work will be paid for at the contract unit price each for OBJECT MARKER - TYPE 1, TYPE 2, OR TYPE 3.

**SECTION 726. MILE POST MARKER ASSEMBLY**

**726.01 Description.** This work shall consist of furnishing and installing a milepost marker at the location specified in the plans.

**726.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) Sign Panel Type 1 .....  | 1092            |
| (b) Metal Posts and Hardware for Highway Markers,<br>Signs and Delineators ..... | 1006.29         |
| (c) Sign Face .....  | 1091            |

**726.03 Basis of Payment.** This work will be paid for at the contract unit price each for MILE POST MARKER ASSEMBLY.

## SECTION 727. SIGN SUPPORT – BREAKAWAY

**727.01 Description.** This work shall consist of furnishing and installing galvanized structural steel breakaway sign supports or galvanized hollow structural steel tubular breakaway sign supports and stub posts.

**727.02 Materials.** Materials shall be according to the following Articles of Section 1000.

| Item  | Article/Section |
|---|-----------------|
| (a) Structural Steel .....                            | 1006.04         |
| (b) Sign Supports .....                               | 1093.01         |
| (c) High Strength Steel Bolts, Nuts and Washers ..... | 1006.08         |

Hollow structural steel tubing shall be according to ASTM A 500 (Grade B) or ASTM A 501.

All other structural steel shapes and plates shall be according to AASHTO M 270M (M270).

Shims shall be fabricated from stainless steel shim stock according to ASTM A 240M (A240), Type 302 or 304.

## CONSTRUCTION REQUIREMENTS

**727.03 General.** Sign locations shall be staked by the Contractor and approved by the Engineer prior to installation of sign supports and structures.

The Contractor and the Engineer together shall determine the exact lengths required before ordering the supports to be fabricated.

Breakaway sign posts and breakaway tubular sign posts shall be according to the plans, and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The steel sign supports shall be fabricated and inspected according to Articles 505.03 through 505.05 All welding shall be continuous and according to Article 505.04.

All fabrication shall be completed and ready for assembly before galvanizing. No punching or drilling shall be permitted after galvanizing.

The slot and 16 mm (5/8 in.) diameter hole in the web and the fuse plate bolt holes in the flange shall be made before galvanizing. The post flange shall be saw cut after galvanizing and bare metal surfaces shall be coated with an approved zinc

solder or zinc-rich paint. These surfaces shall not be coated until the fuse plate is installed and all bolts fully tightened.

After fabrication, the post, fuse plate, base plate, and upper 150 mm (6 in.) of the stub post shall be galvanized by the hot-dip process according to AASHTO M 111.

The sign supports shall be erected in a vertical position on stub posts previously cast into the foundations. The faces of the supports shall be flush with the sign throughout the contact area. The supports shall be plumbed and brought to final grade.

The top of the supports shall be set within 50 mm (2 in.) of, but not above, the top of the sign when installed at the height specified. When two or more sign supports are required for any sign, the supports shall be erected parallel to each other.

Shims may be used between the plates to level posts.

Posts shall be assembled to stubs with high strength bolts and washers as detailed on the plans.

The bolts in the base plate shall be tightened in a systematic order to the required torque.

Each bolt shall be loosened and tightened to the required torque in the same order as the initial tightening.

Threads at the junction of the bolt and nut shall be burred or center punched to prevent the nut from loosening.

**727.04 Welding.** All welding shall be continuous and according to Article 505.04(r).

**727.05 Tightening.** All friction fuse bolts shall be tightened in the shop as approved by the Engineer and according to the current Specifications of Structural Joints using AASHTO M 164M (M164) bolts and one of the following methods:

- (1) Turn-of-Nut Tightening
- (2) Tightening by use of a Direct Tension Indicator

Tightening shall obtain the following minimum residual tension on each bolt:

| Min. Residual<br>Bolt Tension |               | Min. Residual<br>Bolt Tension |              |
|-------------------------------|---------------|-------------------------------|--------------|
| Bolt Dia.                     | kN (lb)       | Bolt Dia.                     | kN (lb)      |
| M12 (1/2 in.)                 | 50.6 (12,050) | M22 (7/8 in.)                 | 182 (39,250) |
| M16 (5/8 in.)                 | 94.2 (19,200) | M24 (1 in.)                   | 212 (51,500) |
| M20 (3/4 in.)                 | 147 (28,400)  | M27 (1 1/8 in.)               | 275 (56,450) |
|                               |               | M30 (1 1/4 in.)               | 337 (71,700) |



**727.06 Foundations.** Sign support foundations shall be of the type indicated on the plans.

- (a) Cast-in-Place. Cast-in-Place concrete foundations shall be according to Section 503.
- (b) Precast. Precast foundations shall be according to Section 504.

**727.07 Method of Measurement.** This work will be measured for payment in kilograms (pounds) of structural steel sign support erected in place.

The measurement of the structural steel shall be computed on the basis of the mass (weight) per meter (foot) of the support, multiplied by the combined length of the main posts and stub posts.

The measurement of the tubular steel shall be computed on the basis of the Post Mass (Weight) Calibration Table shown on the plans for the main posts installed, plus the mass (weight) of the stub posts.

No allowance will be made for the mass (weight) of the welds, either shop or field, and for the galvanizing.

**727.08 Basis of Payment.** This work will be paid for at the contract unit price per kilogram (pound) for STRUCTURAL STEEL SIGN SUPPORT-BREAKAWAY or TUBULAR STEEL SIGN SUPPORT-BREAKAWAY.

All miscellaneous hardware for both the stub post and main post shall be included in the contract unit price bid for the sign support specified. No allowance will be made for overrun and no deduction made for cuts, copes and holes.

Concrete foundations will be paid for according to Article 734.05

## **SECTION 728. TELESCOPING STEEL SIGN SUPPORT**

**728.01 Description.** This work shall consist of furnishing and installing telescoping steel sign supports for ground-mounted signs utilizing a telescoping base section or a previously installed cast iron base.

**728.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item                          | Article/Section |
|-------------------------------|-----------------|
| (a) Steel – Telescoping ..... | 1093.01         |

## **CONSTRUCTION REQUIREMENTS**

**728.03 General.** The estimated length of a support includes the total length of all required sections. When two or more posts support the same sign, they shall be erected parallel to each other with the tops of the posts at the same elevation.

The sign locations shall be staked by the Contractor and approved by the Engineer prior to installation of the posts. The Contractor shall be responsible for the proper elevation, offset, and orientation of all signs as indicated in the plans or as directed by the Engineer.

When the support specified is too long, the Contractor may choose to cut the top section or telescope the top section farther into the base section. Any section cut shall have the cut end completely deburred.

When signs are to be placed on adjacent post sides and the posts have holes in only two opposite sides, the Contractor shall drill any additional holes necessary to the tolerances according to Article 1093.01(a)(3).

The top section may be spliced. Splicing shall be done according to the plans and will only be permitted in the upper third of the top section. Only one splice per support will be permitted. The internal splice member shall be 45 mm (1 3/4 in.) by 45 mm (1 3/4 in.).

#### **728.04 Installation Methods.**

- (a) Pavement Mount. Pavement mounted installation shall be used only in paved areas and shall consist of three sections as shown in the plans. The base sections may be installed before or after the paving operation, except a hole no greater than 150 mm (6 in.) in diameter shall be cut in the pavement.

Any pavement removed shall be neatly replaced around the base section with like material to the depth of the original pavement.

The 57 mm (2 1/4 in.) by 57 mm (2 1/4 in.) base section shall be driven by hand or mechanical means to a minimum depth of 850 mm (34 in.) measured from the pavement surface. The top of the base section shall be protected by a suitable driving cap. When required by the Engineer, the earth around the support shall be compacted after driving.

The sleeve section shall be telescoped over the base section or may be driven with the base section as a unit. The tops of both sections shall be at the same elevation, with the bolt holes aligned.

The 50 mm (2 in.) by 50 mm (2 in.) top section shall be telescoped into the base section a minimum of 200 mm (8 in.) and a maximum of 300 mm (12 in.) and the three sections fastened together as shown in the plans.

- (b) Ground Mount. Ground mounted installations shall consist of two sections as shown in the plans. The 55 mm (2 1/4 in.) by 55 mm (2 1/4 in.) base section shall be driven by hand or mechanical means to a minimum depth of 1.5 m (5 ft) measured from the ground line or as shown in the plans. The top of the base section shall be protected by a suitable driving cap. When required by the Engineer, the earth around the support shall be compacted after driving.

The 50 mm (2 in.) by 50 mm (2 in.) top section shall be telescoped into the base section a minimum of 200 mm (8 in.) and a maximum of 200 mm (12 in.) and the two sections fastened together as shown in the plans.

- (c) **Base Casting.** Base casting shall consist of two sections as shown in the plans. The base section shall be 57 mm (2 1/4 in.) by 57 mm (2 1/4 in.) by 216 mm (8 1/2 in.). This section shall be inserted at least 170 mm (6 3/4 in.) into the base casting to form a shim into which the 50 mm (2 in.) section is placed. The top section shall be inserted at least 170 mm (6 3/4 in.) into the base casting. After the top section is in place, the installation shall be bolted together as shown in the plans.

**728.05 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for TELESCOPING STEEL SIGN SUPPORT. No additional compensation will be allowed for the different sizes in sections, for any pavement patching required, any cutting or deburring of the top section, drilling holes, or telescoping of a top section more than 300 mm (12 in.) into a base section. Payment for the base casting will be made according to Section 731.

## SECTION 729. METAL POST

**729.01 Description.** This work shall consist of furnishing Type A and/or Type B metal posts, and installing them utilizing the direct burial method.

**729.02 Materials.** Materials shall be according to the following Article of Section 1000 - Materials:

| Item                 | Article/Section |
|----------------------|-----------------|
| (a) Metal Post ..... | 1006.29         |

## CONSTRUCTION REQUIREMENTS

**729.03 General.** The metal posts may be driven by hand or mechanical means to a minimum depth of 1.0 m (3.5 ft) for Type A or 1.2 m (4.0 ft) for Type B. The depths shall be measured from the ground line. The post shall be protected by a suitable driving cap and when required by the Engineer, the material around the post shall be compacted after driving.

Scratching, chipping, or other damage to the posts shall be avoided during handling and installation. If chips and/or scratches occur, the areas shall be recoated in the field by a method meeting the coating manufacturer's recommendations. Chips and scratches totaling more than five percent of the surface area of any one post and/or more than five percent of the surface area in any 300 mm (1 ft) segment of any one post shall be cause for rejection of the post.

When the post specified is too long, the Contractor may choose to cut the post to the required length or increase the embedment. Any post cut shall be installed with the cut end at the bottom.

**729.04 Method of Measurement.** The metal post will be measured for payment in meters (feet). The length to be measured shall be the total length installed as shown on the plans.

**729.05 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for METAL POST - TYPE A or TYPE B. No extra compensation will be allowed for cutting or for increasing the embedment of a post.

**SECTION 730. WOOD SIGN SUPPORT**

**730.01 Description.** This work shall consist of furnishing and installing nominal 100 mm (4 in.) by 150 mm (6 in.) wood sign supports for ground-mounted signs.

**730.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item                             | Article/Section |
|----------------------------------|-----------------|
| (a) Wood .....                   | 1007            |
| (b) Preservative Treatment ..... | 1007.12         |

**CONSTRUCTION REQUIREMENTS**

**730.03 General.** All 100 mm (4 in.) by 150 mm (6 in.) wood posts shall be modified to satisfy the breakaway requirements by drilling 38 mm (1 1/2 in.) diameter holes centered at 100 mm (4 in.) and 450 mm (18 in.) above the groundline and perpendicular to the centerline of the roadway.

When the support specified is too long, the Contractor may choose to dig the hole deeper or to cut the support to the required length. All cut ends shall become the tops of the supports and shall have the cut end swabbed with a mixture of not less than five percent pentachlorophenol and petroleum solvent before the signs are mounted.

**730.04 Installation Methods.** The wood sign supports shall be installed with the 150 mm (6 in.) dimension parallel to the adjacent edge of pavement, utilizing one or both of the following methods as specified in the plans.

- (a) Wood sign supports shall be placed in a vertical hole not exceeding 300 mm (12 in.) in diameter and not less than 1.5 m (5 ft) deep. The support shall be placed in the center of the hole and backfilled with stone screenings, thoroughly tamped in 300 mm (12 in.) lifts. The stone screenings shall be CA 6, according to Article 1004.01. Not less than 14 days after the placing of the sign assembly on the post, the Contractor shall inspect each installation, and straighten and retamp around each post as required.
- (b) Concrete Foundation. Wood supports shall be placed in the concrete foundation to a depth of 900 mm (3 ft). After placement in the foundation, the post shall be shimmed as necessary with wooden wedges inserted

between the post and the sides of the foundation so as to securely hold the post in a vertical position to the satisfaction of the Engineer.

**730.05 Method of Measurement.** Wood sign supports will be measured for payment in meters (feet). The length to be measured will be the total length installed. Any embedment over 150 mm (6 in.) beyond that shown in the plans will not be included for measurement.

**730.06 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for WOOD SIGN SUPPORT. No extra compensation will be allowed for any cutting and treating.

Payment for the concrete foundation will be according to Section 734.

## SECTION 731. CAST IRON BASE FOR TELESCOPING STEEL SIGN SUPPORT

**731.01 Description.** This work shall consist of furnishing and installing a cast iron base for telescoping steel sign supports.

**731.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item  | Article/Section |
|---|-----------------|
| (a) Base for Telescoping Steel Sign Support ..... | 1093.02         |
| (b) Aluminum Paint .....                          | 1008            |

## CONSTRUCTION REQUIREMENTS

**731.03 General.** Base castings installed on sidewalks or median islands shall be affixed with three anchor rods.

The base casting shall be leveled by using corrosion resistant washers as shims at the anchor rod locations and under the base casting.

**731.04 Method of Measurement.** The base castings will be measured for payment in individual units complete in place.

**731.05 Basis of Payment.** This work will be paid for at the contract unit price each for BASE FOR TELESCOPING STEEL SIGN SUPPORT.

## SECTION 732. PRECAST CONCRETE FOUNDATION FOR WOOD SIGN SUPPORT

**732.01 Description.** This work shall consist of furnishing and installing a precast reinforced concrete foundation for wood sign supports.

**732.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item                               | Article/Section |
|------------------------------------|-----------------|
| (a) Portland Cement Concrete ..... | 1020            |
| (b) Reinforcement Bars .....       | 1006.10         |
| (c) Coarse Aggregate .....         | 1004            |

**CONSTRUCTION REQUIREMENTS**

**732.03 General.** Concrete foundations shall be constructed according to the applicable requirements of Section 734. Foundations shall be placed in a vertical hole at least 150 mm (6 in.) deeper than the length of the foundation. The bottom of the hole shall be covered with enough coarse aggregate to allow the top of the foundation to be a maximum of 75 mm (3 in.) above the ground.

A foundation hole less than 300 mm (12 in.) diameter requires no backfilling or tamping. A hole diameter 300 mm (12 in.) to 375 mm (15 in.) shall be backfilled with sand. A hole diameter exceeding 375 mm (15 in.) shall be backfilled with suitable material approved by the Engineer and tamped in 300 mm (12 in.) lifts.

Reinforcement bars shall be No. 10 (No. 3) and shall be according to Section 508.

**732.04 Basis of Payment.** This work will be paid for at the contract unit price each for CONCRETE FOUNDATIONS FOR WOOD SIGN SUPPORT.

**SECTION 733. OVERHEAD SIGN STRUCTURES**

**733.01 Description.** This work shall consist of fabricating, furnishing, and erecting span, monotube, cantilever or bridge mounted type, overhead sign structures including supports on previously prepared foundations and/or installing an overhead sign structure walkway on span or cantilever overhead sign structures.

**733.02 Materials.** Materials shall be according to the sign structure detail sheets included in the plans and the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) High – Strength Steel Bolts, Nuts, and Washers ..... | 1006.08         |
| (b) Anchor Rods .....                                    | 1094.03         |
| (c) Fabric Bearing Pads .....                            | 1082.01         |
| (d) Overhead Sign Structures .....                       | 1094            |

**CONSTRUCTION REQUIREMENTS**

**733.03 Drawings.** Two sets of shop fabrication drawings for each overhead sign structure shall be submitted to the Engineer for approval according to Article 505.03.

**733.04 Fabrication.** Structural steel shall be fabricated and inspected according to the applicable portions of Articles 505.04 and 505.05. Aluminum shall be fabricated according to Article 1094.06 and the following:

Materials shall be sawed or milled. Thermal cutting will not be permitted. Holes in extruded alloys shall be drilled. All holes in castings shall be cored and reamed for final fit. All holes in forgings shall be drilled from solid or formed and reamed for final fit. In handling aluminum materials in the shop and in the field, every precaution shall be taken to avoid scoring and marring of the surfaces, and any such scoring or marring of the surfaces, sufficient in the opinion of the Engineer to give an objectionable appearance, shall be cause for rejection of material. Cast or forged parts shall have all fins or other irregularities removed. Tubing shall be seamless and uniform in quality and temper. Exterior and interior surfaces shall be clean, smooth, and free from seams, slivers, laminations, grooves, cracks, or other defects.

**733.05 Reserved.**

**733.06 Surface Treatment of Structural Steel Supports.** Structural steel supports shall be hot dipped galvanized according to AASHTO M 111 after fabrication is completed.

**733.07 Erection.** Erection of all structural steel and structural aluminum shall be according to the applicable requirements of Article 505.08. High strength bolts, nuts, and washers shall be assembled and tightened according to Article 505.04(f)(3). Following are the requirements for using other bolts:

- (a) Bolts, nuts, and washers used for assembling the steel or aluminum shall be according to Article 1006.29(d).
- (b) Stainless steel bolts, nuts, and washers used for assembling the aluminum truss sections of simple-span structures or fastening aluminum cantilevers to steel columns shall comply with Article 1006.29(d) and the following requirements. Bolt and nut threads shall be cleaned and lightly oiled prior to field assembly. Based on tests of identical assemblies submitted to the Engineer for approval, the installation torque will produce a preload representing 70 to 80 percent of the material's minimum required yield strength at the thread's cross sectional (tensile stress) area. For ASTM A 193M (A193) Grade B8 or B8M, Class 1 bolts with coarse (UNC) threads, the preload ranges required, as verified by instrumented tests, shall be as follows:

| Nominal<br>Diameter<br><u>mm</u> | Preload<br>Range<br><u>kN</u> | UNC Bolt<br>Size<br><u>in.</u> | Preload<br>Range<br><u>lbs</u> |
|----------------------------------|-------------------------------|--------------------------------|--------------------------------|
| M20                              | 36 - 40                       | 3/4                            | 7000 - 8000                    |
| M22                              | 44 - 50                       | 7/8                            | 9700 - 11000                   |
| M24                              | 51 - 58                       | 1                              | 12700 - 14500                  |
| M27                              | 67 - 76                       | 1-1/8                          | 16000 - 18300                  |
| M30                              | 81 - 93                       | 1-1/4                          | 20300 - 23200                  |
| M36                              | 119 - 135                     | 1-3/8                          | 24200 - 27700                  |

**733.08 Wire Cloth.** The void between the base plate and the foundation shall be enclosed according to the following requirements:

A stainless steel mesh 6 mm (1/4 in.) maximum opening with a minimum wire diameter of 1.5 mm (AWG No. 16) with a minimum 50 mm (2 in.) lap shall be installed to enclose the void between the base plate and the foundation. The stainless steel screen wire shall be formed to the shape of the base plate and fastened to the base plate with 19 mm (3/4 in.) stainless steel banding. The screen wire shall overlap and be fastened with a ring type connection.

**733.09 Field Painting.** Field painting for all exposed steel surfaces not galvanized shall be done according to the plans and the requirements of the latest paint system provisions for structural steel.

**733.10 Method of Measurement.**

- (a) Sign Structure - Span Cantilever or Monotube Span. Cantilever or monotube sign structures, will be measured for payment in meters (feet) from center to center of supports or from end of the unsupported end to center of the support as shown on the plans. The measurement shall include the end supports. For steel or aluminum, three dimensional space frame trusses, the measurement shall include the truss inspection grating inside the truss.
- (b) Sign Structure - Bridge Mounted. Bridge mounted overhead sign structures will be measured for payment in meters (feet) of the overall length of the walkway.
- (c) Sign Structure Walkway. The sign structure walkway will be measured for payment in meters (feet) of the overall length of the walkway, end to end.

**733.11 Basis of Payment.** This work will be paid for at the contract unit price per meter (foot) for OVERHEAD SIGN STRUCTURE - SPAN, OVERHEAD SIGN STRUCTURE - CANTILEVER or OVERHEAD SIGN STRUCTURE - MONOTUBE of the width and depth specified, or OVERHEAD SIGN STRUCTURE - BRIDGE MOUNTED and/or OVERHEAD SIGN STRUCTURE WALKWAY.

**SECTION 734. CONCRETE FOUNDATIONS FOR SIGN STRUCTURES**

**734.01 Description.** This work shall consist of constructing Class Sl concrete foundations for the installation of structural steel sign supports and overhead sign structures.

**734.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item                               | Article/Section |
|------------------------------------|-----------------|
| (a) Portland Cement Concrete ..... | 1020            |
| (b) Grounding Electrode .....      | 1087.01(b)      |



## CONSTRUCTION REQUIREMENTS

**734.03 General.** Concrete foundations of the type and size specified in the plans, shall be constructed according to the applicable requirements of Section 503 and the following:

- (a) Spread Foundations for Overhead Sign Structures. Unless the contract plans were designed based on actual soil data for the site with specific bearing capacity requirements, the footing shall be placed on cohesive soil having a minimum unconfined compressive strength of 120 kPa (2500 psi) as determined by the Engineer. If the bearing capacity does not meet the minimum requirements the foundation design will be re-evaluated. The footings shall be constructed according to the applicable requirements of Article 503.14. Conduit, when specified, shall be installed rigidly in place before the concrete is deposited. The top 100 mm (4 in.) of backfill material shall be topsoil suitable for seeding.

Backfill shall be placed prior to the structural steel support frames. It shall be placed in 100 mm (4 in.) layers and shall be compacted by hand operated mechanical tampers to give a compaction of at least 90 percent of the maximum density shown on the dry weight curve as determined by the Standard Compaction Test. Care shall be taken to prevent damage to the concrete. Backfill shall be brought level to the finished ground line. All areas disturbed by the Contractor's operations shall be seeded according to Section 250.

The anchor rods shall be firmly held in position by a template during the placing of the concrete.

The top of the foundation shall be finished level, and all exposed surfaces shall be finished according to Article 503.16(a).

- (b) Drilled Shaft Foundations for Overhead Sign Structures. The drilling of the holes shall be accomplished by means of either truck mounted or crane mounted earth augers. The drill unit used shall be such that the shafts can be excavated to the diameters, alignment, and depth required. Material excavated by drilling shall be disposed of by the Contractor outside the limits of the right-of-way.

If boulders or masonry foundations are encountered below natural ground during drilling, the holes shall continue through these obstructions. After drilling operations and excavation for the tie beam have been completed, all loose material existing at the bottom of the hole shall be removed before placing concrete.

The Contractor shall have available a suitable light for the inspection of the drilled hole for its entire depth. All holes will be examined for straightness. Any hole upon visual inspection from the top which shows less than one-half the diameter of the hole at the bottom will be rejected.

Water shall not be permitted to enter the holes, and all water which may have infiltrated into the hole shall be removed before placing concrete. If dewatering of the drilled hole cannot be readily accomplished without loss of ground or creating quick conditions, the hole shall be lined and tremied concrete shall be used.

Suitable casings shall be furnished and placed when required to prevent caving of the hole before concrete is placed. Casings, if used in drilling operations, shall be removed from the hole as concrete is placed. The bottom of the casing shall be maintained not more than 1.5 m (5 ft) nor less than 300 mm (1 ft) below the top of the concrete during withdrawal and placing operations, unless otherwise permitted by the Engineer. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

The method of placing concrete in the shafts shall be subject to the approval of the Engineer at all times, and the method used shall provide a continuous flow with no segregation of the concrete materials.

The reinforcing cage shall be placed and secured symmetrically about the axis of the shaft and shall be securely blocked to clear the sides of the hole.

- (c) Concrete Foundations for Ground-Mounted Sign Supports. The top segment of these foundations shall be finished according to Article 503.16(a) and formed down to a depth of at least 300 mm (1 ft) below the ground line, and the concrete shall be finished level at the ground line.

**734.04 Method of Measurement.** This item will be measured for payment according to Article 503.21.

**734.05 Basis of Payment.** This work will be paid for at the contract unit price per cubic meter (cubic yard) for CONCRETE FOUNDATIONS, or DRILLED SHAFT CONCRETE FOUNDATIONS.

Granular backfill, when required, will be paid for according to Article 109.04.

Seeding will not be measured for payment but will be considered included in this Item.

If it becomes necessary to revise the dimensions of the foundations from those shown in the plans, the additional excavating and backfilling, except granular backfill when required, will be considered included in this item.

Rock excavation will be classified and paid for according to Section 502.

When the contract does not contain a unit price for rock excavation for structures and rock is encountered, it will be paid for according to Article 109.04.

### **SECTION 735. RELOCATE OVERHEAD SIGN STRUCTURE OR GROUND MOUNTED SIGN SUPPORT**

**735.01 Description.** This work shall consist of removing a span, monotube or cantilever overhead sign structure complete with support(s) and/or a ground mounted sign support, and installing it at another location using either the existing supports or new supports.

**735.02 Relocation.** The new foundation shall be constructed according to Section 734, and the old foundation shall be removed according to Section 737.

- (a) Overhead Sign Structure. The complete horizontal section of the overhead sign structure shall be removed from the support(s) and the support(s) removed from the foundation(s). The complete overhead sign structure shall then be transported to its new location and erected according to Section 733, using new nuts and washers on the foundation(s).
- (b) Ground Mounted Sign Supports. Each support shall be removed from the foundation, transported to its new location, and erected on a foundation.

All materials required for erecting the relocated support, such as mounting hardware, shims, etc., shall be considered as part of the support.

**735.03 Basis of Payment.** This work will be paid for at the contract unit price each for RELOCATE OVERHEAD SIGN STRUCTURE - SPAN or CANTILEVER, RELOCATE MONOTUBE OVERHEAD SIGN STRUCTURE - SPAN or CANTILEVER, or RELOCATE GROUND MOUNTED SIGN SUPPORT.

### **SECTION 736. REMOVE OVERHEAD SIGN STRUCTURE**

**736.01 Description.** This work shall consist of removing a span, monotube, cantilever or bridge-mounted overhead sign structure.

**736.02 Removal.** The entire overhead sign structure, including sign panels and sign lighting, is to be removed from the right-of-way. The removed structure shall be disposed of according to the contract.

Concrete foundations shall be removed according to Section 737.

**736.03 Basis of Payment.** This work will be paid for at the contract unit price each for REMOVE OVERHEAD SIGN STRUCTURE - SPAN or CANTILEVER, REMOVE OVERHEAD SIGN STRUCTURE, MONOTUBE - SPAN or CANTILEVER, or REMOVE OVERHEAD SIGN STRUCTURE - BRIDGE MOUNTED.

### **SECTION 737. REMOVE GROUND MOUNTED SIGN SUPPORT AND/OR CONCRETE FOUNDATIONS**

**737.01 Description.** This work shall consist of removing a ground-mounted sign support and/or concrete foundations.

Art. 738.01 Remove, Replace, And Reerect Overhead Sign Structure

**737.02 Removal.**

- (a) Ground - Mounted Sign Support. The ground-mounted sign support is to be completely removed from the right-of-way within 24 hours after removal of the sign panel. The removed support shall become the property of the Contractor, and any salvage value received shall be reflected in the bid price.

Sign panels shall be removed according to Section 724.

- (b) Concrete Foundations. All components of the concrete foundation, including the concrete, reinforcing, stub post, and electrical items, shall be removed at least 300 mm (1 ft) below the ground line.

The use of explosives of any kind will not be permitted in removing concrete foundations.

The hole shall be backfilled with suitable material approved by the Engineer. The surface of the filled hole shall be treated to match the surrounding area.

Seeding will not be measured for payment but shall be considered as included in this item. Seeding shall be done according to applicable portions of Section 250.

All debris resulting from this operation shall be removed from the right-of-way.

Concrete foundations for overhead sign structures shall be removed within five calendar days after the removal of the overhead sign structure.

**737.03 Basis of Payment.** This work will be paid for at the contract unit price each for REMOVE GROUND-MOUNTED SIGN SUPPORT and/or REMOVE CONCRETE FOUNDATION-GROUND MOUNT or OVERHEAD.

**SECTION 738. REMOVE, REPLACE, AND REERECT OVERHEAD SIGN STRUCTURE - SPAN, MONOTUBE, OR CANTILEVER**

**738.01 Description.** This work shall consist of removing a sign structure, replacing damaged components and reerecting the overhead sign structure.

**738.02 Materials.** Drawings, fabrication, welding of structural steel, surface treatment of structural steel supports, erection, wire cloth, galvanizing and the replacement of nuts, bolts, and washers shall be according to the applicable portions of Section 733.

**738.03 Removal.**

- (a) Structural Steel Support. The damaged structural steel end support shall be removed, replaced and moved from the right-of-way. The support shall become the property of the Contractor. Any salvage value shall be reflected

in the bid price. This work shall also include the removal of an existing sign panel, if one is present, and reinstallation of the same sign panel on the new end support, and the installation of a sign structure number as directed by the Engineer.

- (b) **Overhead Sign Structure.** The Contractor shall remove the entire overhead sign structure, including sign panels, sign lighting or walkway, from its support(s) and properly anchor the structure on blocks. The entire overhead sign structure shall be reerected, when the structure is reattached to the supports including the replacement of any damaged hardware.

Saddle shim blocks and fabric pads shall remain in their proper position during reerection.

The district where this work is being performed shall be responsible for disconnecting the sign lighting prior to removal of the overhead structure and reconnecting the sign lighting after the overhead structure has been reerected.

**738.04 Basis of Payment.** This work will be paid for at the contract unit price each for STRUCTURAL STEEL SUPPORT FOR OVERHEAD SIGN STRUCTURE - SPAN or CANTILEVER. Removing and reerecting the overhead sign structure will be paid at the contract unit price each for REMOVE AND REERECT OVERHEAD SIGN STRUCTURE-SPAN CANTILEVER.

## PAVEMENT MARKING

### SECTION 780. PAVEMENT STRIPING

**780.01 Description.** This work shall consist of furnishing and applying pavement marking.

**780.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item  | Article/Section |
|---|-----------------|
| (a) Thermoplastic Pavement Markings .....           | 1095.01         |
| (b) Painted Pavement Markings .....                 | 1095.02         |
| (c) Preformed Plastic Pavement Markings .....       | 1095.03         |
| (d) Epoxy Pavement Marking .....                    | 1095.04         |
| (e) Preformed Thermoplastic Pavement Markings ..... | 1095.05         |
| (f) Glass Beads for Pavement Markings .....         | 1095.07         |

**780.03 Equipment.** Equipment shall be according to the following Articles of Section 1100.

| Item   | Article/Section |
|--|-----------------|
| (a) Thermoplastic Truck Mounted (Note 1).....  | 1105.01         |
| (b) Thermoplastic Hand Operated (Note 1) ..... | 1105.01         |
| (c) Epoxy .....                                | 1105.02         |

Note 1. A mechanical beader approved by the Engineer shall be used.

**CONSTRUCTION REQUIREMENTS**

**780.04 General.** Thermoplastic and epoxy pavement markings shall only be applied by Contractors on the list of Approved Contractors maintained by the Engineer of Operations and in effect on the date of advertisement for bids.

Pavement marking on freeways shall be placed with truck-mounted equipment. Markings on roads other than freeways may be placed with either truck-mounted or hand-operated equipment.

Before applying the pavement marking material, the pavement shall be clean, dry and free of debris or any other material that would reduce the adhesion of the markings on the pavement.

The edge of a center line or lane line shall be offset a minimum distance of 50 mm (2 in.) from a longitudinal crack or joint. Edge lines shall be approximately 50 mm (2 in.) from the edge of pavement. The finished center and lane lines shall be straight, with the lateral deviation of any 3 m (10 ft) line 25 mm (1 in.) or less.

Pavement marking words and symbols shall conform closely to the dimensions and spacing specified in the MUTCD and the plans. Deviations from the required dimensions and spacing or other departures from reasonable standards of professionalism will be cause for rejection by the Engineer.

The words and symbols shall be as specified in Table 1 in Article 780.12.

**780.05 Thermoplastic.** New thermoplastic material shall not be applied over existing pavement markings. The Contractor shall remove all existing material which may cause premature failure of the new material.

The Contractor shall remove the existing pavement markings prior to applying the thermoplastic pavement markings, the area removed shall be no wider than the width of the existing pavement markings. The new thermoplastic pavement markings shall be applied over the location where the pavement markings were removed.

The Contractor shall notify the Engineer 72 hours prior to the placement of the thermoplastic markings. At the time of this notification, the Contractor shall indicate the manufacturer and lot numbers of thermoplastic and glass beads he/she intends to use.

The compound shall be installed in a molten state at a minimum temperature of 205 °C (400 °F) and maximum temperature of 245 °C (475 °F). Scorching or discoloration of material will be cause for rejection by the Engineer. The machinery shall be constructed so all mixing and conveying parts, up to and including the shaping-die, maintain the material in a molten state.

Thermoplastic shall be applied only when the pavement temperature is 13 °C (55 °F) or greater and no later than November 1 or earlier than April 15. If the thermoplastic markings cannot be placed according to these specifications and the road is to be opened to traffic between November 1 and April 15 and no adequate pavement markings are in place, the Contractor shall, at the direction of the Engineer, place temporary pavement markings according to Section 703. The Contractor shall remove the temporary pavement markings and place the thermoplastic pavement markings on or after April 15 or as agreed upon by the Engineer.

A binder sealer shall be applied on all bituminous pavements over 60 days old and on all portland cement concrete pavement surfaces where the new thermoplastic material is to be installed. The binder sealer material shall be applied as recommended by the manufacturer of the thermoplastic and in sufficient quantities to entirely cover the surface on which the thermoplastic is to be laid.

The thermoplastic material shall be applied at a thickness of not less than 2.50 mm (0.100 in.) but no greater than 2.75 mm (0.110 in.). Finished lines shall be within 6 mm (0.25 in.) of the width specified in the plans.

The Contractor shall place the thermoplastic markings with an adequate drop on glass beads according to Article 1095.01, uniformly applied to assure adequate nighttime reflectivity. It shall be the Contractor's responsibility to use a compatible combination of thermoplastic material and beads to preclude the surface beads from sinking deeply into the thermoplastic.

The thickness of the markings will be measured above the pavement surface at random points as selected by the Engineer, to determine conformance.

- (a) If the measurements show less than 2.50 mm (0.100 in.), the Engineer will "chip" the edges of the markings at random points and measure the thickness of the chips to determine if the overall thickness of the markings is at least 2.50 mm (0.100 in.). When either the overall thickness or the thickness above the pavement surface is substantially in conformance with the thickness requirements, payment will be made at 100 percent of the contract unit prices involved.
- (b) If the thickness at a given location is less than 2.50 mm (0.100 in.), additional measurements will be taken on each side of the location by the Engineer to determine the extent of the deficient portion of the marking. If the average thickness of the deficient portion is less than 2.50 mm (0.100 in.) but more than 1.50 mm (0.060 in.), an adjusted unit price of 50 percent of the contract unit price involved will be used in computing payment for the area which is deficient.
- (c) If the measurements show the average thickness to be less than 1.50 mm (0.060 in.), the Contractor shall grind away the surface of the deficient

portions of the markings sufficiently to reduce the average thickness to approximately 1.25 mm (0.050 in.) or less. The Contractor shall then apply additional thermoplastic material and beads to bring the thickness of the markings to at least 2.50 mm (0.100 in.) and the reflectivity to the minimum required values.

**780.06 Paint.** Prior to application of the paint pavement marking, the Contractor shall make certain the pavement surface is dry and free of dirt or grease and, if necessary, clean the surface to the satisfaction of the Engineer.

Paint shall not be applied at air temperatures below 10 °C (50 °F), unless approved by the Engineer.

The paint shall be applied at a minimum thickness of 406 µm (16 mils) and beads shall be applied to all painted surfaces at the minimum rate of 720 g for each L (6.0 lb for each gal) of paint used.

Unless directed by the Engineer, lines shall not be laid directly over a tar or asphalt painted lines.

**780.07 Preformed Plastic.** The markings shall be capable of being applied on either newly paved asphalt concrete surfaces by being inlaid into the surface, or on new and existing portland cement concrete and asphalt concrete surfaces, by means of a pressure-sensitive, precoated adhesive, or a liquid contact cement which shall be applied at the time of installation.

The pavement shall be cleaned as recommended by the manufacturer.

Cleaning operations shall not begin until a minimum of 30 days after the placement of new concrete.

The cleaning operation shall remove all visible evidence of curing compound on the peaks and valleys of textured concrete surfaces, remove all loose and flaking material and round any sharp edges and irregularities.

When recommended by the manufacturer a primer sealer shall be applied on all pavement surfaces where new preformed plastic pavement marking material is to be applied. The primer sealer shall be recommended by the manufacturer of the preformed plastic pavement material and shall be compatible with the material being used. The primer sealer shall be applied in sufficient quantities to entirely cover the pavement surface where the plastic material is to be placed. The Contractor shall not install the preformed plastic pavement markings until the primer sealer dries according to the manufacturer's recommendations.

The markings placed on the pavement shall be rolled and compacted onto the pavement with a roller or tamper cart approved by the manufacturer. This roller shall be loaded with or weigh at least 90 kg (200 lb). The Contractor shall tamp and roll the material sufficiently to prevent easy removal or peeling. Rolling of letters, symbols and materials 300 mm (12 in.) or wider shall not be with a vehicle, but with an approved roller. Care shall be taken to cut the material in and around pavement joints or cracks and roll the material into the cracks of joints.



- (a) Type A. On freshly placed asphalt concrete, the inlaid markings shall be applied before final compaction and when the pavement temperature has cooled to approximately 65 °C (150 °F) and when, in the opinion of the Engineer, the pavement is acceptable for vehicular traffic.

The markings shall be applied at a minimum thickness of 1.5 mm (0.06 in.).

The markings shall be placed on the pavement by means of a mechanical applicator or by a hand method and embedded into the pavement surface with a compaction roller with minimum water on the roller. Vibrators shall not be used.

The initial rolling of the markings shall be in the same direction as the application to minimize buckling in front of the roller. The roller shall not be allowed to turn on the markings.

The markings shall be embedded to a depth of approximately 1.0 mm (0.04 in.) and to the satisfaction of the Engineer.

- (b) Type B or C. The material shall be applied only when the air temperature is 15 °C (60 °F) or above and rising and the pavement temperature is 21 °C (70 °F) or greater and in no case later than October 15 for non-inlaid applications. When the preformed plastic markings cannot be placed according to these specifications and the road is to be opened to traffic after October 15 with no adequate pavement markings in place, the Contractor shall at the direction of the Engineer, place preformed tape for lane lines. All other pavement markings shall be placed according to Article 703.05. The Contractor shall then place the preformed pavement markings on or as soon after April 15 as the requirements of these specifications can be met or at such time as may be agreed upon by the Engineer. Payments for placing these temporary pavement markings will be according to Article 703.07.

**780.08 Preformed Thermoplastic.** The pavement markings shall be capable of being applied on either asphalt surfaces or portland cement concrete surfaces by using a propane blowtorch.

When recommended by the manufacturer of the preformed pavement marking material, a primer sealer shall be applied on portland cement concrete surfaces prior to application of the preformed thermoplastic pavement marking material. The primer sealer material shall be applied in sufficient quantities to entirely cover the pavement surface where the pavement marking material is to be placed.

The pavement temperature and the ambient air temperature shall be at or above 0 °C (32 °F) at the time of installation of the pavement markings.

**780.09 Epoxy.** The pavement shall be cleaned by a method approved by the Engineer to remove all dirt, grease, glaze, or any other material that would reduce the adhesion of the markings with minimum or no damage to the pavement surface. New portland cement concrete pavements shall be blast-cleaned to remove all latents.

Markings shall be applied to the cleaned surface on the same calendar day. If this cannot be accomplished, the surface area shall be recleaned prior to applying the markings. No markings shall be placed until the Engineer approves the cleaning.

Widths, lengths, and shapes of the cleaned surface shall be of sufficient size to include the full area of the specified pavement marking to be placed or removed.

The cleaning operation shall be a continuous moving process with minimum interruption to any traffic.

The material shall be applied to the cleaned road surface at  $0.51 \pm 0.01$  mm (20 mils  $\pm$  1 mil) in thickness, before the glass beads are applied. Glass beads shall be uniformly applied by means of a double drop pressurized bead applicator system. The system shall apply both the first drop glass beads and the second drop glass beads at a rate of 1.2 kg per L (10 lb/gal). Epoxy pavement marking shall be applied only when the air and surface temperature are a minimum of 2 °C (35 °F) and rising. Where epoxy markings cannot be placed according to these specifications and the road is open to traffic with no adequate pavement markings in place, the Contractor shall place temporary pavement markings according to Article 703.05.

Lane lines shall be applied within four calendar days after removal of any existing lane lines.

The Contractor shall provide the Engineer an accurate temperature measuring device(s) which shall be capable of measuring the pavement temperature prior to the application of the material, the material temperature at the gun tip and the material temperature prior to mixing.

**780.10 Inspection.** The epoxy, thermoplastic, preformed thermoplastic, and preformed plastic Type A, B, or C, pavement markings will be inspected following installation, but no later than October 15 for preformed plastic markings, November 1 for thermoplastic and preformed thermoplastic markings, and December 15 for epoxy markings. In addition, they will be inspected following a winter performance period that extends 180 days from November 1.

Within 15 calendar days after the end of the winter performance period, a final performance inspection will be made. Final acceptance requirements are as follows:

- (a) Lane lines: 90 percent by area of each individual dashed line segment.
- (b) Crosswalks, stop lines, arrows, and words: 90 percent by area of each individual line, symbol, or letter.
- (c) Center lines, edge lines, gore markings, and channelizing lines: 90 percent by area measured over any 3 m (10 ft) length of any individual line regardless of width.
- (d) Entire project: measured in its entirety according to (a), (b), and (c) above, the entire project shall be 95 percent intact.

Upon completion of the final performance inspection, or after satisfactory completion of any necessary correction, the Engineer will notify the Contractor, in

writing, of the date of such final performance inspection and release him/her from further performance responsibility.

If this inspection discloses any work, in whole or in part, which does not meet the inspection requirements, the Contractor shall, within 30 calendar days, completely repair or replace such work to the satisfaction of the Engineer.

This performance inspection and performance acceptance of the epoxy, thermoplastic, preformed thermoplastic, and preformed plastic Type A, B, C pavement markings shall not delay acceptance of the entire project and final payment due if the Contractor requires and receives from the subcontractor a third party "performance" bond naming the Department as obligee in the full amount of all pavement marking quantities listed in the contract, multiplied by the contract unit price. The bond shall be executed prior to acceptance and final payment of the nonthermoplastic items and shall be in full force and effect until final performance inspection and performance acceptance of the thermoplastic, preformed thermoplastic, and preformed plastic pavement markings. Execution of the third party bond shall be the option of the prime Contractor. A third party bond is not required where the prime Contractor performs the thermoplastic work and the retainage is sufficient to cover the cost of such work.

#### **780.11 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of contract quantities shall be according to Article 202.07(a).
- (b) Measured Quantities. The lines will be measured for payment in meters (feet) of thermoplastic, preformed thermoplastic, preformed plastic, epoxy, and paint pavement marking lines applied and accepted, measured in place. Double yellow lines will be measured as two separate lines. Words and symbols shall conform to the sizes and dimensions specified in the Illinois Manual on Uniform Traffic Control Devices and Standard 780001 and will be measured based on the total areas indicated in Table 1 or as specified in the plans.

**780.12 Basis of Payment.** This work will be paid for at the contract unit prices per meter (foot) of applied line width, as specified, for THERMOPLASTIC PAVEMENT MARKING - LINE, PAINT PAVEMENT MARKING - LINE, EPOXY PAVEMENT MARKING - LINE, PREFORMED PLASTIC PAVEMENT MARKING - LINE - TYPE A, B, C, PREFORMED THERMOPLASTIC PAVEMENT MARKING - LINE and/or per square meter (square foot) for THERMOPLASTIC PAVEMENT MARKING - LETTERS AND SYMBOLS, PAINT PAVEMENT MARKING - LETTERS AND SYMBOLS, EPOXY PAVEMENT MARKING - LETTERS AND SYMBOLS, PREFORMED PLASTIC PAVEMENT MARKING - TYPE A, B, OR C - LETTERS AND SYMBOLS, PREFORMED THERMOPLASTIC PAVEMENT MARKING - LETTERS AND SYMBOLS. The Contractor may use preformed plastic pavement marking or thermoplastic pavement marking, meeting the applicable requirements of Sections 1095 and 780, for diagonal lines, stop bars, and letters and symbols in lieu of epoxy at no extra compensation.

When the Contractor has the option of applying Permanent Pavement Marking it shall be Thermoplastic, Preformed Plastic (Type A, B, or C), Epoxy, or Preformed

Thermoplastic Pavement Markings. It will be paid for a the contract unit price per meter (foot) of applied line for PERMANENT PAVEMENT MARKING - LINE 100 (4), 125 (5), 150 (6), 200 (8), 300 (12), 400 (16), or 600 (24) mm (in.) and per square meter (square foot) for PERMANENT PAVEMENT MARKING - LETTERS AND SYMBOLS.

\*TABLE 1

LETTERS  
sq m (sq ft)

| Size            | A             | B             | C             | D             | E             | F             | G             | H             | I             |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1.8 m<br>(6.ft) | 0.28<br>(3.1) | 0.37<br>(4.0) | 0.25<br>(2.7) | 0.31<br>(3.4) | 0.31<br>(3.3) | 0.24<br>(2.6) | 0.31<br>(3.3) | 0.31<br>(3.4) | 0.14<br>(1.5) |
| 2.4 m<br>(8 ft) | 0.51<br>(5.5) | 0.66<br>(7.1) | 0.45<br>(4.8) | 0.57<br>(6.1) | 0.55<br>(5.9) | 0.44<br>(4.7) | 0.54<br>(5.8) | 0.56<br>(6.0) | 0.24<br>(2.6) |

| Size            | J             | K             | L             | M             | N             | O             | P             | Q             | R             |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1.8 m<br>(6.ft) | 0.2<br>(2.1)  | 0.28<br>(3.1) | 0.20<br>(2.2) | 0.39<br>(4.2) | 0.37<br>(4.0) | 0.31<br>(3.4) | 0.28<br>(3.0) | 0.33<br>(3.6) | 0.33<br>(3.6) |
| 2.4 m<br>(8 ft) | 0.34<br>(3.7) | 0.53<br>(5.7) | 0.45<br>(3.8) | 0.69<br>(7.4) | 0.65<br>(7.1) | 0.56<br>(6.0) | 0.49<br>(5.3) | 0.59<br>(6.3) | 0.59<br>(6.3) |

| Size            | S             | T             | U             | V             | W             | X             | Y             | Z             |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1.8 m<br>(6.ft) | 0.30<br>(3.2) | 0.20<br>(2.2) | 0.30<br>(3.2) | 0.25<br>(2.7) | 0.39<br>(4.2) | 0.25<br>(2.7) | 0.20<br>(2.2) | 0.26<br>(2.9) |
| 2.4 m<br>(8 ft) | 0.53<br>(5.7) | 0.35<br>(3.8) | 0.52<br>(5.6) | 0.45<br>(4.8) | 0.68<br>(7.3) | 0.45<br>(4.8) | 0.36<br>(3.9) | 0.47<br>(5.1) |

NUMBERS  
sq m (sq ft)

| Size            | 1             | 2             | 3             | 4             | 5             |
|-----------------|---------------|---------------|---------------|---------------|---------------|
| 1.8 m<br>(6.ft) | 0.14<br>(1.5) | 0.31<br>(3.3) | 0.31<br>(3.3) | 0.26<br>(2.9) | 0.33<br>(3.5) |
| 2.4 m<br>(8 ft) | 0.24<br>(2.6) | 0.54<br>(5.8) | 0.54<br>(5.8) | 0.47<br>(5.1) | 0.57<br>(6.1) |

| Size            | 6             | 7             | 8             | 9             | 0             |
|-----------------|---------------|---------------|---------------|---------------|---------------|
| 1.8 m<br>(6.ft) | 0.33<br>(3.5) | 0.20<br>(2.2) | 0.35<br>(3.8) | 0.33<br>(3.5) | 0.31<br>(3.4) |
| 2.4 m<br>(8 ft) | 0.58<br>(6.2) | 0.35<br>(3.8) | 0.62<br>(6.7) | 0.58<br>(6.2) | 0.56<br>(6.0) |

SYMBOLS

sq m (sq ft)

|  | Large Size  | Small Size  |
|--|-------------|-------------|
| Through Arrow                              | 1.07 (11.5) | 0.60 (6.5)  |
| Left or Right Arrow                        | 1.47 (15.6) | 0.82 (8.8)  |
| Combination Left (Right) and Through Arrow | 2.42 (26.0) | 1.37 (14.7) |
| Railroad "R"<br>1.8 m (6 ft)               | 0.33 (3.6)  |             |
| Railroad "X"<br>6.1 m (20 ft)              | 5.02 (54.0) | --          |
| Handicapped Symbol                         | 0.43 (4.6)  | --          |

\*Table applies to all types of pavement marking materials.

## SECTION 781. RAISED REFLECTIVE PAVEMENT MARKERS

**781.01 Description.** This work shall consist of placing permanent and/or temporary raised reflective pavement markers or replacing the reflective element in a raised reflective pavement marker.

**781.02 Materials.** Materials shall be according to the following Articles of Section 1000 - Materials:

| Item   | Article/Section |
|--|-----------------|
| (a) Raised Reflective Pavement Markers .....           | 1096.01         |
| (b) Temporary Raised Reflective Pavement Markers ..... | 1096.02         |

## CONSTRUCTION REQUIREMENTS

**781.03 General.** The reflector may be attached to the casting prior to or after the placement of the markers. The depression in the web shall be clean and dry. The reflector shall be laminated to an elastomeric pad and adhesively attached to the casting. The protective paper or plastic film covering the adhesive pad shall be removed immediately prior to placing the reflector on the casting. Once the film covering is removed, extreme care shall be taken to avoid contamination of the exposed pad surface. An adhesive meeting the marker manufacturer's specifications shall be used. The adhesive shall be placed either on the reflector or on the web in sufficient quantity so as to ensure complete coverage of the contact area with no voids present and with a slight excess after the reflector is pressed in place.

- (a) Permanent. It shall be the Contractor's responsibility to determine the location of any traffic control devices installed in the pavement before beginning work, and shall conduct work to avoid damage to these devices.

Any damage to these devices caused by the Contractor's operation shall be repaired at the Contractor's expense and to the satisfaction of the Engineer.

The pavement shall be cut to match the bottom contour of the marker using a concrete saw fitted with 450 and 250 mm (18 and 10 in.) diameter blades. Diamond blades shall be used on portland cement concrete pavement. The cut shall be clean and completely dry prior to pouring the epoxy. After the cut is cleaned, the configuration shall be checked using a pavement marker. The marker shall fit easily within the cut with the leveling tabs resting on the pavement. If any force is required to place or remove the marker or if the leveling tabs do not rest on the pavement surface, the cut shall be enlarged as necessary. Installations on crowned pavements, super elevations, or ramps shall be cut deeper than those on level pavements if necessary to get proper marker fit. A rapid setting (hard in one hour) epoxy meeting the requirements of ASTM C 881, Type IV, Grade 2 or 3 shall be poured into the cut to within 9 mm (3/8 in.) of the pavement surface.

The marker shall then be placed into the epoxy-filled cut. The leveling tabs shall rest on the pavement surface and the marker tips shall be slightly below the pavement surface when properly installed. There shall be no epoxy on the reflective lens. The epoxy, when properly mixed, shall be hard cured in 30-45 minutes. If after one hour, a screwdriver or other appointed instrument can be pushed into the epoxy, the marker and the uncured epoxy shall be removed, and the marker shall be cleaned and the unit reinstalled.

The pavement surface temperature and the ambient air temperature shall be at or above 10 °C (50 °F) at the time of installation of the marker for the epoxy adhesive to properly cure.

Unless directed by the Engineer, raised reflective pavement markers shall not be laid directly over a longitudinal crack or joint. The edge of a raised reflective pavement marker shall be offset a minimum distance of 50 mm (2 in.) from the edge of pavement, from a longitudinal crack or joint and from a solid lane line, toward traffic. Raised reflective pavement markers shall be centered in the gap between dashed line segments and the finished line of the markers shall be straight. The lateral deviation on any 3 m (10 ft) line shall not exceed 25 mm (1 in.). Raised reflective pavement markers through tangents of reverse curves which are less than 150 m (500 ft) in length shall be installed at the lesser of the two curve spacings.

The reflectors may be attached to the castings either prior to or after the placement of the markers. The depression in the web shall be clean and dry. The reflector shall be placed on the casting with sufficient pressure to firmly seat it in place, minimum load of 45 kg (100 lb). Adhesive material shall not be permitted on the reflective surface of the prismatic reflector.

- (b) Temporary. The pavement surface which the marker shall be bonded to, shall be free of dirt, curing compound, grease, oil, moisture, or any other material which would adversely affect the bond of the adhesive.

The markers shall be placed firmly on the pavement and pressed into place by slowly passing over them with a truck wheel. The pass shall not displace

the markers. In lieu of an adhesive pad, an adhesive meeting the marker manufacturer's specifications may be used. The adhesive shall be placed either on the reflector or on the web in sufficient quantity so as to ensure complete coverage of the contact area with no voids present and with a slight excess after the reflector is pressed in place.

All markers shall be monodirectional. Markers placed to the left of traffic shall be amber and markers placed to the right of traffic shall be crystal.

- (c) Replacement. All remaining portions of the existing reflector, and all traces of adhesive, rust, dirt, etc., shall be removed from the marker reflector area by sandblasting or other methods approved by the Engineer.

The Contractor shall be responsible for verifying the model numbers of castings as shown on the plans and shall be responsible for installing the proper replacement reflector in each casting.

The Contractor shall make certain the casting surface is dry and free of dirt and rust prior to placing the reflector on the casting.

The reflector shall be placed on the casting with sufficient pressure to firmly seat it in place, minimum load of 45 kg (100 lb). Adhesive material shall not be permitted on the reflective surface of the prismatic reflector. The pavement surface temperature and the ambient air temperature shall be at or above 10 °C (50 °F) at the time of application of the prismatic reflector.

**781.04 Inspection of Raised Reflective Pavement Markers.** The permanent raised reflective pavement marker and/or replacement reflector will be inspected following installation, but no later than November 30. In addition, they will be inspected following a winter performance period that will extend 180 days from November 30.

Within 15 calendar days after the end of the winter performance period, a final performance inspection will be made. If this inspection discloses any work which is not visibly intact and serviceable, the Contractor shall, within 30 calendar days, completely repair or replace such work to the satisfaction of the Engineer.

Measured in its entirety, project shall be 97 percent intact.

Upon completion of the final performance inspection or after satisfactory completion of any necessary corrections, the Engineer shall notify the Contractor in writing of the date of such final performance inspection and release him from further performance responsibility.

This delay in performance inspection and performance acceptance of the raised reflective pavement markers shall not delay acceptance of the entire project and final payment due if the Contractor requires and receives from the subcontractor a third party "performance" bond naming the Department as obligee in the full amount of all raised reflective pavement marker quantities listed in the contract, multiplied by the contract unit price. The bond shall be executed prior to acceptance and final pavement of the nonraised reflective pavement marker items and shall be in full force and effect until final performance inspection and performance acceptance of the

raised reflective pavement markers. Execution of the third party bond shall be the option of the prime Contractor. A third party bond will not be required when the prime Contractor performs the raised reflective pavement marker work and the retainage is sufficient to cover the cost of such work.

**781.05 Basis of Payment.** This work will be paid for at the contract unit price each for RAISED REFLECTIVE PAVEMENT MARKER, TEMPORARY RAISED REFLECTIVE PAVEMENT MARKER, and REPLACEMENT REFLECTOR.

**SECTION 782. PRISMATIC REFLECTORS**

**782.01 Description.** This work shall consist of furnishing and installing prismatic reflectors on concrete barriers, bridge parapet walls, and mountable or barrier curbs.

**782.02 Materials.** Materials shall be according to Articles of Section 1000 - Materials:

| Item                                   | Article/Section |
|--|-----------------|
| (a) Prismatic Barrier Reflectors ..... | 1097            |
| (b) Prismatic Curb Reflectors .....    | 1097            |

**CONSTRUCTION REQUIREMENTS**

**782.03 General.** The surface of the barrier, bridge parapet wall or curb to which the reflector shall be applied shall be free of dirt, curing compound, moisture, paint, or any other material which would adversely affect the bond of the adhesive. Cleaning of the surface shall be to the satisfaction of the Engineer.

An adhesive meeting the reflector manufacturer's specifications shall be placed either on the surface or the bottom of the reflector in sufficient quantity to ensure complete coverage of the contact area with no voids present and with a slight excess after the reflector is pressed firmly in place.

**782.04 Basis of Payment.** This work will be paid for at the contract unit price each for MONODIRECTIONAL or BIDIRECTIONAL, PRISMATIC BARRIER REFLECTOR, and PRISMATIC CURB REFLECTOR. Where bidirectional units (two reflective surfaces) are specified, the Contractor may, at no extra cost to the Department, furnish two separate monodirectional units (single reflective surface) and mount them back to back.

**SECTION 783. PAVEMENT MARKING AND MARKER REMOVAL**

**783.01 Description.** This work shall consist of removing existing pavement markings and raised reflective pavement markers.



**783.02 Equipment.** Equipment shall be according to the requirements of the following Articles of Section 1100 - Equipment.

| Item                           | Article/Section |
|--------------------------------|-----------------|
| (a) Portable Shotblaster ..... | 1101.13         |
| (b) Grinders (Note 1)          |                 |

Note 1. Grinding equipment shall be approved by the Engineer.

**CONSTRUCTION REQUIREMENTS**

**783.03 Removal of Conflicting Markings.**

- (a) Removal of Conflicting Markings. Existing pavement markings that conflict with revised traffic patterns shall be removed as directed by the Engineer and shall be scheduled immediately to facilitate a change in lane assignments which requires removal of conflicting markings. If darkness or inclement weather prohibits the removal operations, such operations shall be resumed the next morning or when weather permits. In the event of removal equipment failure, such equipment shall be repaired, replaced, or leased so removal operations can be resumed within 24 hours.

The existing pavement markings shall be removed from the pavement by a method that does not materially damage the surface or texture of the pavement or surfacing. Very small particles of tightly adhering existing markings may remain in place, if in the opinion of the Engineer, complete removal of the small particles will result in pavement surface damage. Any damage to the pavement or surfacing caused by pavement marking removal shall be repaired by the Contractor at his/her own expense by methods acceptable to the Engineer. Where blast cleaning is used for the removal of pavement markings, care should be taken to protect all vehicular traffic from damage. When permanent raised reflective pavement markers are present and conflict with the revised traffic patterns, only the reflectors shall be removed.

The shape of the obliterated strip shall be disguised so the pattern of the removed marking is not retained. Where mechanical means of marking removal have been employed, flat paint of a color matching the pavement surface or an asphaltic seal coat may be used if necessary as a means of covering contrasting pavement texture. The cost of the flat paint shall be included in the cost of pavement marking removal. The use of flat paint to cover conflicting pavement markings will not be allowed.

- (b) Raised Reflective Pavement Marking Removal. The removal of existing markers shall consist of the reflective element and the base casting complete. On those improvements where no pavement rehabilitation is required, the pavement shall be repaired with material according to Article 406.11 and to the satisfaction of the Engineer.

**783.04 Cleaning.** The roadway surface shall be cleaned of debris, blast sand or any other deleterious material by the use of jets of compressed air or water. When

the shotblast method is used, the Contractor will be responsible for collecting and recycling the steel shot.

Over cleaning to the extent of possible damage to the roadway surface shall be held to a minimum.

**783.05 Method of Measurement.**

- (a) Contract Quantities. The requirement for use of contract quantities shall be according to Article 202.07(a).
- (b) Measured Quantities. The existing pavement marking removal will be measured in square meters (square feet). For payment purposes, all existing lines, letters and symbols will be measured in square meters (square feet).

**783.06 Basis of Payment.** This work will be paid for at the contract unit price each for RAISED REFLECTIVE PAVEMENT MARKER REMOVAL, or at the contract unit price per square meter (square foot) for PAVEMENT MARKING REMOVAL.